

REPORT OF GEOTECHNICAL SERVICES  
SUBSURFACE HYDROCARBON STUDY  
CHEVRON SERVICE STATION 0129  
SEATTLE, WASHINGTON  
FOR  
CHEVRON U.S.A.

INTRODUCTION

The results of our subsurface hydrocarbon study at Chevron Service Station 0129 are presented in this report. The service station site is located northeast of the intersection between Northeast 47th Street and Brooklyn Avenue Northeast in Seattle, Washington. The site location is shown relative to surrounding physical features on the Vicinity Map, Figure 1.

Chevron Service Station 0129 was undergoing renovation during our initial site visits. The service station renovation consisted of the removal of existing underground fuel storage tanks, fuel lines and service islands, followed by excavation for the installation of new underground gasoline storage tanks, service islands and fuel lines. The general layout of the service station site and the locations of the former underground tanks are shown on the Site Plan, Figure 2. The site is shown relative to surrounding properties in Figure 3.

SCOPE

The purpose of our study is to explore subsurface soil and ground water conditions at the site for the potential presence of residual hydrocarbons. The scope of services completed for this project is listed below.

1. Observe and document the removal of four underground fuel storage tanks and examine these tanks for evidence of corrosion or leaks.
2. Observe and document the removal of fuel service islands and fuel lines.
3. Obtain soil samples from the site's underground facility excavations for field screening tests and for chemical analysis of residual hydrocarbons.

4. Monitor compaction of backfill in the former underground fuel storage tanks excavation.
5. Obtain soil samples from soil stockpiles (soil removed from the underground facility excavations) for chemical analysis to characterize the soil.
6. Obtain permission for transporting soil stockpiles to the Cedar Hills Landfill for disposal.
7. Monitor the drilling of 14 exploratory borings and obtain soil samples from the borings at 5-foot intervals for field screening of residual hydrocarbons.
8. Submit at least one soil sample from each boring for chemical analysis of residual hydrocarbons.
9. Install a 2-inch-diameter PVC monitor well casing with a flush-grade lockable surface monument in each exploratory boring.
10. Develop the well screens by hand bailing with a stainless steel bailer.
11. Determine the well casing rim elevations to an accuracy of 0.01 feet using an engineer's level and an assumed site datum.
12. Measure water table elevations in the wells and sample each well for the presence of liquid hydrocarbons.
13. Measure the air space in each well casing for the presence of hydrocarbon vapors using a Bacharach TLV Sniffer calibrated to hexane.
14. Obtain ground water samples from the monitor wells for chemical analysis of dissolved hydrocarbons. Submit selected ground water samples for chemical analysis of dissolved lead.
15. Monitor the drilling and construction of an 8-inch-diameter liquid hydrocarbon recovery well.

#### SITE DESCRIPTION

The site is generally level and is situated at an elevation of approximately 200 feet above mean sea level. The area around the site slopes toward the south and southwest. The local geology consists of a glacial till cap overlying a thick sequence of sand. The site is located within a commercial and residential area in the University District of

Seattle, Washington (Figure 4). A parking lot and drive-through bank facility are located directly north of the property. A Seafirst Bank facility is located across an alley to the east. Small businesses and residential apartments are located west and south of the site, across Brooklyn Avenue Northeast and Northeast 47th Street. Circle K operates a convenience store/gasoline station on the southwest corner of the intersection between Northeast 47th Street and Brooklyn Avenue Northeast.

The renovated Chevron Service Station facility consists of a convenience store, four service islands and three underground gasoline storage tanks located south of the service islands.

#### REMOVAL OF UNDERGROUND STORAGE TANKS AND RELATED FACILITIES

O'Sullivan (O'Sullivan Construction, Inc.) removed three underground gasoline storage tanks from the northern portion of the site, two service islands, and associated fuel lines between January 3 and 12, 1990. The three removed underground gasoline storage tanks consisted of two 12,000-gallon steel tanks and one 5,000-gallon steel tank. O'Sullivan also completed an excavation in the southwestern portion of the site for the installation of the site's new underground gasoline storage tanks during this time. An abandoned 1,000-gallon underground fuel storage tank was discovered on January 8, 1990 in the eastern portion of the new gasoline tank excavation. The tank had been filled with pea gravel at the time of abandonment. We were unable to determine the type of fuel that had been stored in the abandoned tank. The location of the former underground facilities are shown in Figure 2.

A representative of GeoEngineers was present to observe the removal of the site's underground facilities and to obtain soil samples from the resulting excavations. Minor pitting and corrosion were observed on the southernmost gasoline tanks during removal procedures. No pitting or corrosion was observed on the northern gasoline tank. Severe corrosion was observed on the abandoned fuel tank. No holes were observed in any of these tanks.

The backfill surrounding the former underground facilities and some of the adjacent native soil was excavated and stockpiled temporarily on site. The backfill and native soil were placed in four separate soil stockpiles.

The soil stockpiles included (1) a stockpile from the former gasoline tanks excavation, (2) a stockpile from the area surrounding the abandoned fuel tank, (3) a stockpile from the eastern fuel line/service island excavation, and (4) a stockpile from the western fuel line/service island excavation. Additionally, soil removed from the new gasoline tank excavation was placed in two separate soil stockpiles.

The underground facilities excavations ranged in depth from 4 feet (fuel line excavations) to 15 feet (former gasoline tank excavation) below the ground surface. Ground water not observed in any of the excavations. The limits of the underground facilities excavations are shown in Figure 2.

#### BACKFILLING OF THE EXCAVATIONS

The former gasoline tank and fuel line/service island excavations were backfilled between January 5 and 7, 1990 with stockpiled soil which earlier had been removed from these excavations and with soil obtained during the excavation for the new gasoline tanks. We recommended to O'Sullivan that the backfill be compacted to at least 95 percent of the laboratory maximum dry density, based on the ASTM D-1557 compaction test procedure. A GeoEngineers representative evaluated the compaction and in-place density of the backfill placed in the excavation on January 5, 1990 and again on January 9, 1990 after the backfilling procedures were completed. GeoEngineers was not on site to monitor the entire backfilling and compaction operations.

GeoEngineers made additional compaction recommendations to O'Sullivan, based on the results of our January 5 and 9, 1990 field testing. Our compaction test results from January 5 and 9, 1990 indicated that the backfill in the northeast quadrant of the former gasoline tank excavation was less than the recommended 95 percent of the laboratory maximum dry density. We recommended that the contractor remove 1 to 2 feet of the backfill in this area and that additional compaction effort be applied to attain the proper compaction. At Chevron's request, a GeoEngineers representative visited the site to evaluate the subgrade footing excavation for the extension of the service station canopy on January 17, 1990. Based

on this site visit, we recommended to the contractor that further compaction effort be applied to bring compaction from loose to dense in the subgrade footing excavation.

#### SUBSURFACE SOIL CONDITIONS

Subsurface soil conditions at the site were observed during the removal and installation of underground facilities and explored by drilling 15 exploratory borings (MW-1 through MW-14 and R-1) at the locations shown in Figures 4 and 5. Details of the field exploration program and the boring logs are presented in Appendix A.

Borings MW-1 and R-1 encountered medium stiff to hard silt at approximately 27 and 30 feet below the ground surface, respectively.

#### GROUND WATER CONDITIONS

Ground water conditions were explored by constructing 2-inch-diameter monitor wells in 14 of the exploratory borings (MW-1 through MW-14) and an 8-inch-diameter recovery well (R-1). Construction details for the wells are presented in Appendix A.

Ground water was encountered in each exploratory boring. Water levels were measured in 12 of the 14 monitor wells (MW-2 through MW-7 and MW-9 through MW-14) on February 28 and May 8, 1990. The water level in R-1 was measured on May 8, 1990. The depth to ground water in the 12 monitor wells ranged from approximately 14 to 17.5 feet beneath the ground surface at the time of our measurements on February 28, 1990. The ground water levels were approximately 0.5 feet lower on May 8, 1990 than on February 28, 1990. The depth to ground water in R-1 was approximately 16 feet below the ground surface on May 8, 1990. Water table elevations based on our February 28 and May 8, 1990 measurements are shown in Figures 4 and 5, respectively. Based on these water table elevations, the shallow ground water beneath the site migrates generally toward the southeast.

The service station design plans were changed during the service station renovation procedures. As a result of the change in plans, MW-1 is located directly beneath the new location of the northeastern service island. A horizontal extension pipe was placed on the wellhead to provide access to the well for future abandonment purposes and for vapor concentration/ground vacuum measurements.

The depth to ground water was measured at 15.84 feet below the ground surface in MW-8 on February 8, 1990. Well MW-8 was found to be plugged at a depth of approximately 15 feet on February 20, 1990, three weeks after it was installed. Well MW-8 was destroyed during final service station renovation procedures.

#### SUBSURFACE HYDROCARBONS AND SOIL CHEMISTRY

The potential presence of hydrocarbons in the subsurface was evaluated by:

1. Performing field screening tests on soil samples obtained from the excavations and exploratory borings. The field screening methods employed included visual examination, sheen testing, and headspace vapor testing. The field screening methods are described in Appendix A.
2. Submitting selected soil samples from each excavation and exploratory boring for one or more of the following chemical analyses: BETX (benzene, ethylbenzene, toluene and xylenes) by EPA Method 8020 and fuel hydrocarbons (gasoline and diesel) by EPA Method 8015 (modified).
3. Submitting soil samples from the soil stockpiles for one or more of the following chemical analyses to characterize the soil: TPH (total petroleum hydrocarbons) by EPA Method 418.1; fuel hydrocarbons by EPA Method 8015 (modified); BETX by EPA Method 8020; PCBs (polychlorinated biphenyls) by EPA Method 8080; EP Toxicity (metals); and purgeable halocarbons by EPA Method 8010.
4. Submitting ground water samples from each monitor well for chemical analysis of BETX by EPA Method 8020 and fuel hydrocarbons by EPA Method 8015 (modified).
5. Submitting a sample of liquid hydrocarbons for chemical analysis of fuel hydrocarbons by EPA Method 8015 (modified).
6. Measuring the air space in the monitor well casings for hydrocarbon vapors using a Bacharach TLV Sniffer calibrated to hexane.

#### EXCAVATIONS AND SOIL STOCKPILES

Field screening results indicated the presence of residual hydrocarbons in soil from: (1) the base and the walls of the former gasoline tanks excavation, (2) the eastern fuel line/service island excavation, (3) the fuel line excavation for the new gasoline tanks, and (4) the southeast and northeast base, and the south wall of the new underground gasoline tanks excavation. Field screening detected little or no evidence of residual hydrocarbons in soil from the base and walls of the other excavations.

Discrete soil samples were obtained from the base and walls of each excavation for chemical analysis of residual hydrocarbons. Approximate soil sample locations are shown in Figure 2. Chemical analytical results for soil samples obtained from each excavation are summarized in Table 1. Laboratory reports are presented in Appendix B.

Chemical analytical results indicated that residual fuel hydrocarbons remain in the former gasoline tanks excavation. Soil samples obtained from the base of the excavation resulted in fuel hydrocarbon concentrations, quantified as gasoline, ranging from 897 ppm to 8,190 ppm (Sample Nos. 900104-2, 900104-5 and 900104-6). Benzene concentrations for these samples ranged from 0.60 ppm to 15.5 ppm. Chemical analytical results of soil samples obtained from the walls of the excavation indicated nondetectable concentrations of fuel hydrocarbons. Benzene was also not detected in the soil samples obtained from the excavation walls. Chemical analysis of ethylbenzene, toluene, and xylenes in soil samples obtained from the excavation walls resulted in concentrations ranging from less than 0.05 to 7.64 ppm.

Chemical analytical results indicated that residual fuel hydrocarbons and BETX were not detected in soil samples obtained from the vicinity of the abandoned fuel storage tank.

Fuel hydrocarbons, quantified as gasoline, were detected at a concentration of 1,023 ppm (Sample No. 900112-25) in the south wall of the new gasoline tanks excavation. Chemical analysis resulted in concentrations of fuel hydrocarbons, quantified as gasoline, ranging from less than 10 ppm to 122 ppm in other portions of the new gasoline tanks excavation. Benzene was detected at a concentration of 0.92 ppm, the sample (Sample No. 900112-31) from the base of the excavation's northeast corner. Benzene

was not detected in the other soil samples obtained from the excavation. Chemical analysis of ethylbenzene, toluene, and xylenes resulted in concentrations ranging from less than 0.05 ppm to 85.1 ppm in soil samples obtained from the new gasoline tanks excavation.

Chemical analysis of fuel hydrocarbons, quantified as gasoline, in the east fuel line excavation resulted in 4,397 ppm (Sample No. 900110-15) and 24 ppm (Sample No. 900108-13). Benzene concentrations were 0.49 ppm in Sample No. 900110-15 and less than 0.05 ppm in Sample No. 900108-13. Ethylbenzene, toluene, and xylene concentrations ranged from 0.64 ppm to 138 ppm in the soil samples obtained from the east fuel line excavation.

Chemical analysis of fuel hydrocarbons, quantified as gasoline, resulted in 470 ppm (Sample No. 900110-14) in the east service island excavation and 955 ppm (Sample No. 900110-16) in the west fuel line/service island excavation. Benzene concentrations were 0.49 ppm in Sample No. 900110-14 and less than 0.05 ppm in Sample No. 900110-16. Ethylbenzene, toluene, and xylene concentrations ranged from less than 0.05 ppm to 17.4 ppm in these soil samples.

Composite soil samples were obtained from the site's soil stockpiles and from exploratory boring soil cuttings for chemical analysis of residual hydrocarbons. Soil below the abandoned fuel tank was also tested for the presence of PCBs, purgeable halocarbons, and selected metals because the contents of the tank were unknown. Based on the results of our initial site studies a vapor extraction system was installed at the site to remediate subsurface hydrocarbons. A composite sample was also obtained from a soil stockpile created by excavating trenches for the VES. Chemical analytical results for the soil stockpiles are summarized in Table 2. Laboratory reports are presented in Appendix B.

#### **EXPLORATORY BORING SOIL SAMPLES**

Field screening tests on soil samples from 14 exploratory borings indicated the presence of residual hydrocarbons in MW-1, MW-2, MW-3, MW-4, MW-7, MW-10, MW-11 and MW-12. Soil from the recovery well boring was not field screened or submitted for chemical analysis. Field screening



indicated the presence of residual hydrocarbons in MW-1 through MW-4, MW-7, MW-10, MW-12 and MW-13. Field screening data are presented on the monitor well logs in Appendix A.

Soil samples from each boring were selected for chemical analysis on the basis of field screening results and depth. Chemical analytical results for these soil samples are summarized in Table 3. Laboratory reports are presented in Appendix C.

Chemical analysis of the soil samples resulted in fuel hydrocarbon concentrations, quantified as gasoline, ranging from 45 ppm to 5,568 ppm in MW-3, MW-4 and MW-12. Benzene was detected in MW-3, MW-4, MW-7 and MW-12 at concentrations of 27.1 ppm, 1.58 ppm, 0.17 ppm and 0.77 ppm, respectively. Concentrations of ethylbenzene, toluene, and xylenes ranging between 0.10 to 614 ppm were also detected in MW-3, MW-4, MW-7, MW-8, MW-11, MW-12 and MW-13. Fuel hydrocarbon and BETX concentrations were nondetectable in soil samples submitted from the other exploratory borings.

#### GROUND WATER CHEMISTRY

Liquid hydrocarbons were detected on the water table in MW-4 and MW-12. Measurements taken on February 28, 1990 indicated that MW-4 and MW-12 contained 2.27 and 1.22 feet of liquid hydrocarbons, respectively. A product sample was submitted from MW-4 which indicated that the product was gasoline. The results of the product sample analysis are presented in Table 4.

Ground water samples were obtained from the monitor wells between January 23 and February 20, 1990. Chemical analytical data for the ground water samples from each well with the exception of MW-4 are summarized in Table 5. Ground water samples were not obtained from MW-4 due to the presence of liquid hydrocarbons in the well. Laboratory reports are presented in Appendix C.

Chemical analytical results of fuel hydrocarbons indicated a concentration of 2,038 ppm gasoline in the ground water sample from MW-12. Fuel hydrocarbon concentrations, quantified as gasoline, ranged from 25 ppm to 526 ppm in MW-2, MW-3 and MW-6 through MW-11. Ground water from the remaining wells contained nondetectable concentrations of fuel hydrocarbons. Benzene concentrations ranged from 0.088 ppm to 29.1 ppm in 8 of the

14 monitor wells. Benzene was not detected in ground water samples from MW-5, MW-6, MW-13 and MW-14. Concentrations of ethylbenzene, toluene, and xylenes ranged from less than 0.001 ppm to 49.7 ppm in all of the ground water samples submitted. (Ground water from monitor wells MW-1 through MW-3 was analyzed for dissolved lead.) Dissolved lead was not detected in these wells.

#### HYDROCARBON VAPORS

The monitor well casings were tested for the presence of hydrocarbon vapors on February 28, 1990 and on April 14, 1990, using a Bacharach TLV Sniffer calibrated to hexane. The vapor concentrations measured are summarized in Table 5. Hydrocarbon vapor concentrations ranged from less than 400 ppm to greater than 10,000 ppm.

#### SOIL STOCKPILE DISPOSAL

The portions of soil stockpiles from the new gasoline tanks excavation which were not used to backfill other excavations on site were transported to two landfills for disposal after chemical analytical results were received. Approximately 450 cubic yards of this soil did not contain concentrations of residual fuel hydrocarbons and were transported to Coal Creek Landfill for disposal. Approximately 450 cubic yards of additional stockpiled soil from the exploratory borings and from the VES installation trenches contained concentrations of residual hydrocarbons and were transported to Cedar Hills Landfill for disposal.

Soil cuttings obtained during drilling of MW-1 through MW-14 were transported to Cedar Hills Landfill for disposal. Soil cuttings obtained during drilling of the recovery well, RW-1, were transported to Pacific Topsoil for disposal. Chemical testing of samples from the soil stockpiles and drill cuttings are summarized in Table 2.

#### LIMITATIONS

This report has been prepared for use by Chevron U.S.A. in their evaluation of subsurface hydrocarbons at Chevron Service Station 0129 in Seattle, Washington. This report may be made available to regulatory agencies. The report is not intended for use by others and the information contained herein may not be applicable to other sites.

The data reported herein are based on the sampling of several excavations and 14 monitor well borings at the service station property. It is always possible that additional subsurface hydrocarbons may exist in areas that were not explored and sampled.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No other conditions, express or implied, should be understood.

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If you have any questions concerning this report, please call.

Respectfully submitted,

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TABLE 1 (Page 1 of 2)  
 SUMMARY OF SOIL CHEMICAL ANALYTICAL RESULTS  
 OBTAINED FROM UNDERGROUND FACILITY EXCAVATIONS (1)

Soil Sample Number (2)	Date Sampled	Location	Depth (ft)	BETX (ppm) (3)				Fuel Hydrocarbons (ppm) (4)		Field Screening	
				B	E	T	X	Gasoline	Diesel	Vapor Concentration (ppm) (5)	Sheen (6)
900103-1	01/03/90	FORMER GASOLINE TANK EXCAVATION									
		North Wall	6.0	ND	ND	ND	ND	ND	ND	<100	SS
900104-2	01/04/90	Base - North Tank	14.0	15.5	145	1,024	754	8,190	ND	>10,000	HS
900104-3	01/04/90	East Wall	7.5	0.35	0.86	0.07	7.64	ND	ND	<100	SS
900104-4	01/04/90	West Wall	7.0	ND	ND	ND	ND	ND	ND	<100	SS
900104-5	01/04/90	Base - Middle Tank	13.0	0.60	15.4	27.1	107	897	ND	1,500	HS
900104-6	01/04/90	Base - South Tank	14.0	1.80	26.2	62.1	151	2,254	ND	2,500	SS
900104-7	01/04/90	South Wall	6.0	ND	0.10	ND	0.63	ND	ND	<100	SS
		ABANDONED FUEL STORAGE TANK									
		South Wall	7.0	ND	ND	ND	ND	ND	ND	<100	SS
900108-17	01/10/90	South Wall	7.0	ND	ND	ND	ND	ND	ND	<100	SS
900108-18	01/10/90	East Wall	7.0	ND	ND	ND	ND	ND	ND	<100	SS
900108-19	01/10/90	West Wall	7.0	ND	ND	ND	ND	ND	ND	<100	SS
900108-20	01/10/90	North Wall	7.0	ND	ND	ND	0.60	ND	ND	110	SS

Notes:

- (1) Chemical analysis by Sound Analytical Service. Laboratory reports are presented in Appendix B.
- (2) Sample locations are shown in Figure 2.
- (3) BETX = benzene, ethylbenzene, toluene and xylenes by EPA Method 8020. Detection limit is 0.05 ppm.
- (4) Fuel hydrocarbons by EPA Method 8015 modified. Detection limit is 10 ppm.
- (5) Vapor measurements were obtained by using a Bacharach TLV Sniffer calibrated to hexane.
- (6) "NS" indicates "no sheen"; "SS" indicates "slight sheen"; "MS" indicates "moderate sheen"; "HS" indicates "Heavy Sheen"
- "<" indicates "less than"; ">" indicates "greater than"; "ft" indicates "feet"
- "ppm" indicates "parts per million"; "ND" indicates "not detected"

TABLE 1 (Page 2 of 2) (1)

Soil Sample Number (2)	Date Sampled	Location	Depth (ft)	BETX (ppm) (3)				Fuel Hydrocarbons (ppm) (4)		Field Screening		
				B	E	T	X	Gasoline	Diesel	Vapor Concentration (ppm) (3)	Sheen (6)	
		NEW GASOLINE TANK EXCAVATION										
900108-9	01/08/90	West Wall	7.0	ND	ND	ND	ND	ND	ND	<100		SS
900108-10	01/08/90	North Wall	7.0	ND	ND	ND	ND	ND	ND	<100		NS
900108-11	01/08/90	East Wall	7.0	ND	ND	ND	ND	ND	ND	<100		SS
900108-12	01/08/90	Base (North end)	15.0	ND	ND	ND	ND	ND	ND	<100		NS
900112-21	01/12/90	Base (Southwest Corner)	15.0	NT	NT	NT	NT	NT	NT	500		MS
900112-22	01/12/90	South Wall (Southwest Corner)	13.0	ND	ND	ND	0.11	ND	ND	<100		HS
900112-23	01/12/90	West Wall (Center)	6.0	ND	ND	ND	0.15	ND	ND	<100		NS
900112-24	01/12/90	Base (Southwest Center)	14.0	ND	ND	ND	0.14	ND	ND	<100		SS
900112-25	01/12/90	South Wall (Center)	9.5	ND	ND	0.27	8.04	1,023	ND	1,200		HS
900112-29	01/12/90	East Wall (So. Center)	9.7	ND	ND	ND	0.16	ND	ND	<100		SS
900112-31	01/12/90	Base (Northeast Corner)	14.0	0.92	9.1	12.3	85.1	122	ND	>10,000		HS
		FUEL LINE/SERVICE ISLAND EXCAVATIONS										
900108-13	01/08/90	East Fuel Line	4.0	0.49	0.64	1.38	3.63	24	ND	4,000		MS
900110-15	01/10/90	East Fuel Line	4.5	ND	16.4	17.5	138	4,397	ND	2,100		HS
900110-14	01/10/90	East Service Island	4.5	0.49	1.02	3.25	17.4	470	ND	2,300		MS
900110-16	01/10/90	West Fuel Line/Service Island	4.5	ND	0.78	0.47	4.25	955	ND	<100		SS

Notes:

- (1) Chemical analysis by Sound Analytical Service. Laboratory reports are presented in Appendix B.
- (2) Sample locations are shown in Figure 2.
- (3) BETX = benzene, ethylbenzene, toluene and xylenes by EPA Method 8020. Detection limit is 0.05 ppm.
- (4) Fuel hydrocarbons by EPA Method 8015 modified. Detection limit is 10 ppm.
- (5) Vapor measurements were obtained by using a Bacharach TLV Sniffer calibrated to hexane.
- (6) "NS" indicates "no sheen"; "SS" indicates "slight sheen"; "MS" indicates "moderate sheen"; "HS" indicates "Heavy Sheen" "<>" indicates "greater than"; ">" indicates "greater than"; "!" indicates "feet" "ppm" indicates "parts per million"; "ND" indicates "not detected"

TABLE 2 (PAGE 1 OF 3)  
 SUMMARY OF SOIL CHEMICAL ANALYTICAL RESULTS  
 FROM SOIL STOCKPILES (1)

Sample Number	Soil Stockpile Description	Method	Parameter	Concentration (ppm)	Detection Limit (ppm)
900105-8*	Soil from former gasoline tank excavation. This soil was used to backfill the former gasoline tanks excavation.	(EPA Method 8020) Aromatic Volatile Hydrocarbons	Benzene	ND	0.05
			Ethylbenzene	1.02	0.05
			Toluene	0.43	0.05
			Total xylenes	9.10	0.05
		(EPA Method 8015, modified) Fuel Hydrocarbons	Gasoline	356	10
			Diesel	ND	10
900110-16A	Soil from below abandoned UST in the new USTs excavation. This soil was transported to Cedar Hills Landfill for disposal.	(EPA Method 8015, modified) Fuel hydrocarbons	Gasoline	292	10
			Diesel	ND	10
		(EPA Method 418.1) Total Petroleum Hydrocarbons (TPH)	TPH	272	5
			Polychlorinated Biphenols (PCBs)	PCBs	ND
		(EPA Method 8020) Aromatic Volatile Hydrocarbons	Benzene	3.41	0.05
			Ethylbenzene	6.91	0.05
			Toluene	0.16	0.05
			Total Xylenes	24.7	0.05
		EP Toxicity (metals)	Arsenic	ND	0.1
			Barium	0.4	0.1
			Cadmium	ND	0.1
Chromium	ND		0.1		
Lead	ND		0.1		
Mercury	ND		0.05		
Selenium	ND		0.1		
(EPA Method 8010) Purgeable Halocarbons	Tetrachloro-ethylene	0.07	0.1		
900112-30*	Soil from east fuel line/service island excavation. This soil was used to backfill the former gasoline tanks excavation.	(EPA Method 8020) Aromatic Volatile Hydrocarbons	Benzene	ND	0.05
			Ethylbenzene	ND	0.05
			Toluene	0.16	0.05
			Total xylenes	39.2	0.05
		(EPA Method 8015, modified) Fuel Hydrocarbons	Gasoline	434	10
			Diesel	ND	10

Notes:  
 (1) Chemical analysis by Sound Analytical Service and Analytical Technologies. Laboratory reports are presented in Appendix B.  
 \*\*\* indicates "composite samples"; "NA" indicates "not applicable"; "ppm" indicates parts per million; "ND" indicates "not tested"

TABLE 2 (PAGE 2 OF 3) (1)

Sample Number	Soil Stockpile Description	Method	Parameter	Concentration (ppm)	Detection Limit (ppm)
900112-32*	Soil from west fuel line/service island excavation. This soil was used to backfill the former gasoline tanks excavation.	(EPA Method 8020) Aromatic Volatile Hydrocarbons	Benzene	ND	0.05
			Ethylbenzene	ND	0.05
			Toluene	ND	0.05
			Total xylenes	0.11	0.05
		(EPA Method 8015, modified) Fuel Hydrocarbons	Gasoline	ND	10
			Diesel	ND	10
900112-27*	Soil from new gasoline tanks excavation. This soil was transported to Cedar Hills Landfill for disposal.	(EPA Method 8020) Aromatic Volatile Hydrocarbons	Benzene	ND	0.05
			Ethylbenzene	2.28	0.05
			Toluene	ND	0.05
			Total xylenes	0.11	0.05
		(EPA Method 8015, modified) Fuel Hydrocarbons	Gasoline	266	10
			Diesel	ND	10
		EP Toxicity (metals)	Arsenic	ND	0.1
			Barium	0.3	0.1
			Cadmium	ND	0.1
			Chromium	ND	0.1
			Lead	0.1	0.1
Mercury	ND		0.05		
Selenium	ND		0.1		
Flash Point	Flash Point	147 degrees F.	NA		
	PMCC degrees F				
900112-28*	Soil from new gasoline tanks excavation. This soil was transported to Coal Creek Landfill for disposal.	(EPA Method 8020) Aromatic Volatile Hydrocarbons	Benzene	ND	0.05
			Ethylbenzene	ND	0.05
			Toluene	ND	0.05
			Total xylenes	0.16	0.05

Notes:

(1) Chemical analysis by Sound Analytical Service and Analytical Technologies. Laboratory reports are presented in Appendix B.

\*\*\* indicates "composite samples"; "NA" indicates "not applicable"; "ppm" indicates parts per million"; "ND" indicates "not tested"

TABLE 2 (PAGE 3 OF 3) (1)

Sample Number	Soil Stockpile Description	Method	Parameter	Concentration (ppm)	Detection Limit (ppm)
900207-1	Soil cuttings obtained during the drilling of exploratory borings. This was transported to Cedar Hills Landfill for disposal.	(EPA Method 8020) Aromatic Volatile Hydrocarbons	Benzene	3.58	0.05
			Ethylbenzene	26.9	0.05
			Toluene	52.6	0.05
			Total xylenes	139	0.05
900207-2		(EPA Method 8015, modified) Fuel Hydrocarbons	Gasoline	1,904	10
			Diesel	ND	10
900214-1	Soil stockpiles from trenches for installation of the site's vapor extraction system. This soil was transported to Cedar Hills Landfill for disposal.	(EPA Method 8020) Aromatic Volatile Hydrocarbons	Benzene	ND	0.05
			Ethylbenzene	ND	0.05
			Toluene	ND	0.05
			Total xylenes	ND	0.05
		(EPA Method 8015, modified) Fuel Hydrocarbons	Gasoline	ND	10
Diesel	ND	10			
S-1	Seven 55-gallon barrels of oil cuttings obtained during drilling of the recovery well. This soil was transported to Pacific Topsoil in Bothell, WA.	(EPA Method 8020) Aromatic Volatile Hydrocarbons	Benzene	ND	0.025
			Ethylbenzene	ND	0.025
			Toluene	ND	0.025
			Total xylenes	ND	0.025
		(EPA Method 8015, modified) Fuel Hydrocarbons	Gasoline	ND	5
			Diesel	ND	5

Notes:

(1) Chemical analysis by Sound Analytical Service and Analytical Technologies. Laboratory reports are presented in Appendix B.

\*\*\* indicates "composite samples"; "NA" indicates "not applicable"; "ppm" indicates parts per million; "ND" indicates "not tested"



**TABLE 3**  
**SUMMARY OF SOIL CHEMICAL ANALYTICAL RESULTS**  
**BORING SAMPLES (1)**

Boring Number (2)	Date Sampled	Depth (ft)	BETX (ppm) (3)				Fuel Hydrocarbons (ppm) (4)	
			B	E	T	X	Gasoline	Diesel
MW-1	01/11/90	7	ND	0.10	ND	0.28	ND	ND
MW-1	01/11/90	13	ND	ND	ND	0.18	ND	ND
MW-2	01/11/90	8	ND	0.12	ND	0.14	ND	ND
MW-2	01/11/90	13	ND	0.14	ND	0.31	ND	ND
MW-3	01/12/90	13	ND	ND	ND	0.21	ND	ND
MW-3	01/12/90	18	27.1	88.1	327	614	5,568	ND
MW-4	01/31/90	15.5	1.58	9.71	31.1	52.6	3,267	ND
MW-4	01/31/90	20.5	ND	ND	ND	ND	ND	ND
MW-5	01/31/90	5.5	ND	ND	ND	ND	ND	ND
MW-5	01/31/90	10.5	ND	ND	ND	ND	ND	ND
MW-6	02/01/90	10.5	ND	ND	ND	ND	ND	ND
MW-6	02/01/90	15.5	ND	ND	ND	ND	ND	ND
MW-7	01/30/90	8	ND	ND	ND	ND	ND	ND
MW-7	01/30/90	13	0.17	0.17	0.25	0.93	ND	ND
MW-8	01/30/90	13	ND	ND	ND	0.18	ND	ND
MW-8	01/30/90	18	ND	ND	ND	ND	ND	ND
MW-9	01/30/90	8	ND	ND	ND	0.33	ND	ND
MW-9	01/30/90	13	ND	ND	ND	ND	ND	ND
MW-10	01/29/90	8	ND	ND	ND	ND	ND	ND
MW-10	01/29/90	13	ND	ND	ND	ND	ND	ND
MW-11	01/29/90	13	ND	ND	ND	ND	ND	ND
MW-11	01/29/90	18	ND	ND	0.14	0.34	ND	ND
MW-12	01/30/90	13	ND	ND	ND	0.18	ND	ND
MW-12	01/30/90	23	0.77	1.44	1.19	7.24	45	ND
MW-13	01/29/90	8	ND	ND	ND	ND	ND	ND
MW-13	01/29/90	13	ND	ND	0.12	0.35	ND	ND
MW-14	02/01/90	10	ND	ND	ND	ND	ND	ND
MW-14	02/01/90	15	ND	ND	ND	ND	ND	ND

**Notes:**

(1) Chemical analysis by Sound Analytical Services. Laboratory reports are presented in Appendix C.

(2) Sample locations are shown in Figure 3.

(3) B = benzene, E = ethylbenzene, T = toluene, X = xylenes. BETX by EPA Method 8020.

Detection limit is 0.05 ppm.

(4) Fuel hydrocarbons by EPA Method 8015, modified. Detection limit is 10 ppm.

"ft" indicates "feet"

"ppm" indicates "parts per million"

"ND" indicates "not detected"

TABLE 4  
SUMMARY OF PRODUCT SAMPLE RESULTS (1)

Sample Number (2)	Fuel Hydrocarbons (3) Gasoline	API Gravity	Flash Point PMCC degrees F
MW-4	850,136	52.5	<70

Notes:

- (1) Chemical Analysis by Sound Analytical Services.  
Laboratory results are presented in Appendix C.
  - (2) Sample locations are shown in Figure 3.
  - (3) Fuel hydrocarbons by EPA Method 8015, modified in ppm.
- "<" indicates "less than"

**TABLE 5  
SUMMARY OF GROUND WATER AND HYDROCARBON VAPOR RESULTS  
MONITOR WELLS (1)**

Sample Number(2)	Date Sampled	BETX (ppm)(3)				Fuel Hydrocarbons (ppm)(4)		Dissolved Lead(5)	Hydrocarbon Vapor Concentrations(6) in Well Casings ppm	
		B	E	T	X	Gasoline	Diesel		02/28/90	04/14/90
MW-1	01/22/90	0.088	<0.001	0.043	0.409	ND	ND	ND	NM	NM
MW-2	01/22/90	1.10	0.161	1.09	1.120	25	ND	ND	1,600	1,000
MW-3	01/22/90	1.38	2.06	14.1	12.8	85	ND	ND	4,300	3,700
MW-5	02/19/90	ND	ND	0.005	0.022	ND	ND	NT	2,900	150
MW-6	02/19/90	ND	0.259	0.074	2.43	38.2	ND	NT	1,400	1,100
MW-7	02/19/90	3.28	1.21	8.17	8.01	526	ND	NT	7,000	5,000
MW-9	02/19/90	0.181	0.494	0.489	4.29	99.6	ND	NT	460	240
MW-10	02/19/90	0.431	0.505	0.136	1.99	89.4	ND	NT	2,900	310
MW-11	02/19/90	0.342	2.15	5.43	9.02	244	ND	NT	5,800	3,800
MW-12	02/19/90	29.1	5.56	49.7	28.9	2038	ND	NT	>10,000	>10,000
MW-13	02/20/90	ND	0.078	0.045	0.176	ND	ND	NT	5,900	3,900
MW-14	02/19/90	ND	ND	ND	ND	ND	ND	NT	3,100	2,500

**Notes:**

(1) Chemical analysis by Sound Analytical Services. Laboratory reports are presented in Appendix C.

(2) Sample locations shown in Figure 3.

(3) B = benzene, E = ethylbenzene, T = toluene, X = xylene. Detection limit is 0.001 ppm.

(4) Fuel hydrocarbons by EPA Method 8015, modified. Detection limit is 10 ppm.

(5) Dissolved lead by EPA Method 6010. Detection limit is 0.1 ppm.

(6) Vapor measurements were obtained by using a Bacharach TLV Sniffer calibrated to hexane.

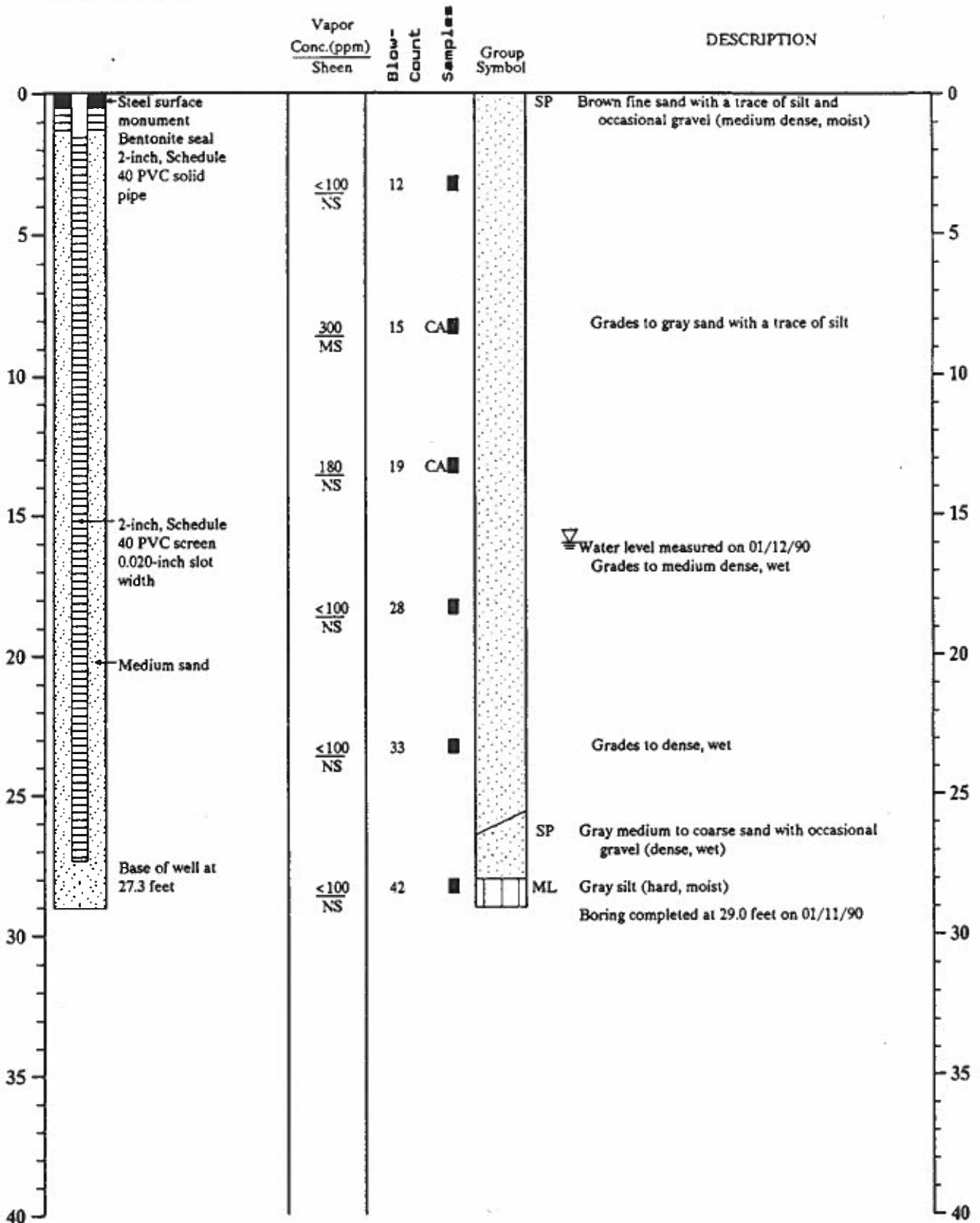
"ppm" indicates "parts per million"; "ND" indicates "not detected"

"<" indicates "less than"; ">" indicates "greater than"

"NM" indicates "not measured"; "NT" indicates "not tested"

# MONITOR WELL NO. MW-1

WELL SCHEMATIC



Note: See Figure A-2 for explanation of symbols

: LRM: CLH: IRA 6/13/90

0372-068-B04



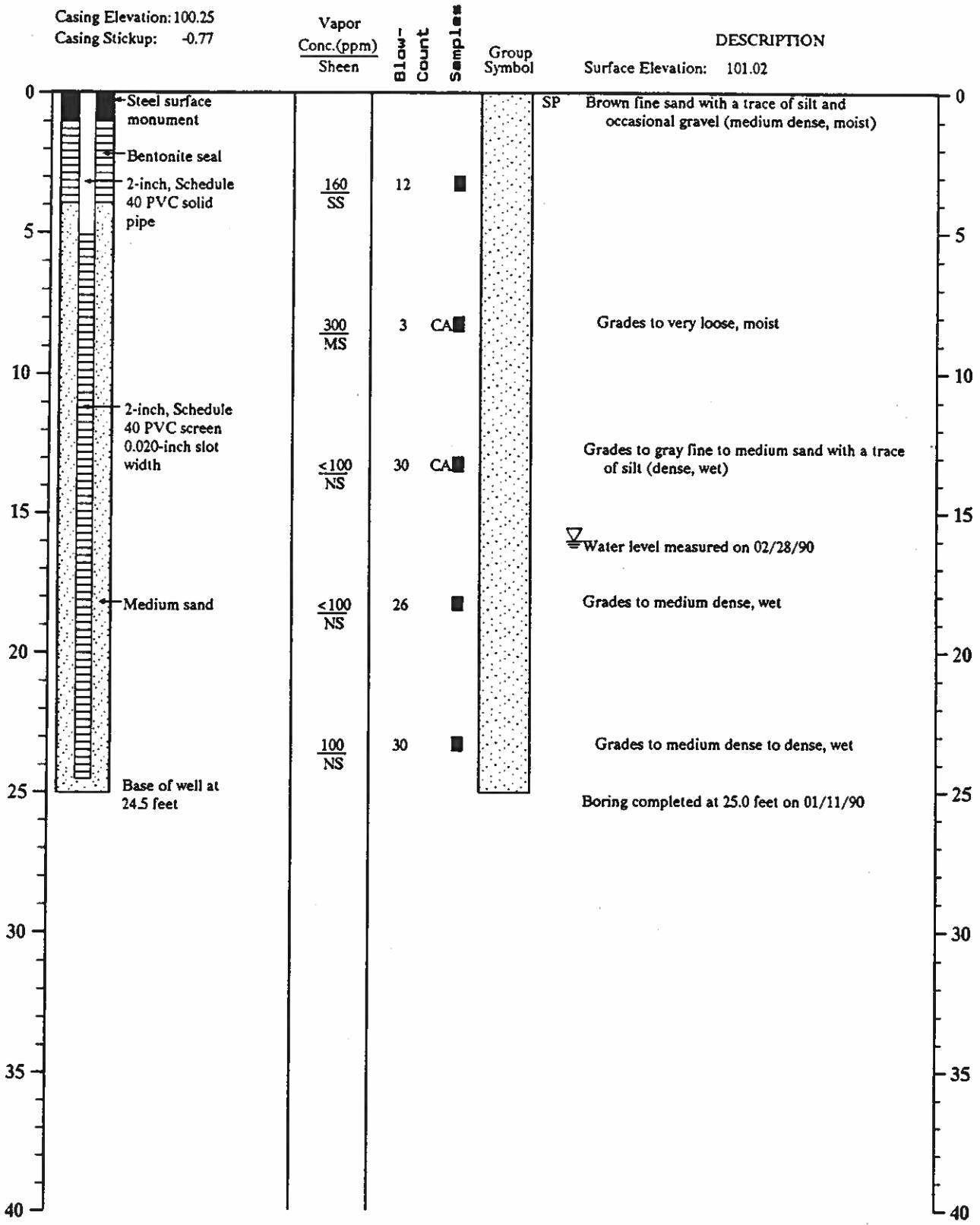
Log of Monitor Well

Figure A-3

# MONITOR WELL NO. MW-2

## WELL SCHEMATIC

Casing Elevation: 100.25  
Casing Stickup: -0.77



Note: See Figure A-2 for explanation of symbols

:LRM:CLH:IRA 6/13/90

0372-068-B04



Log of Monitor Well

Figure A-4

# MONITOR WELL NO. MW-3

## WELL SCHEMATIC

Casing Elevation: 101.05  
Casing Stickup: -0.39

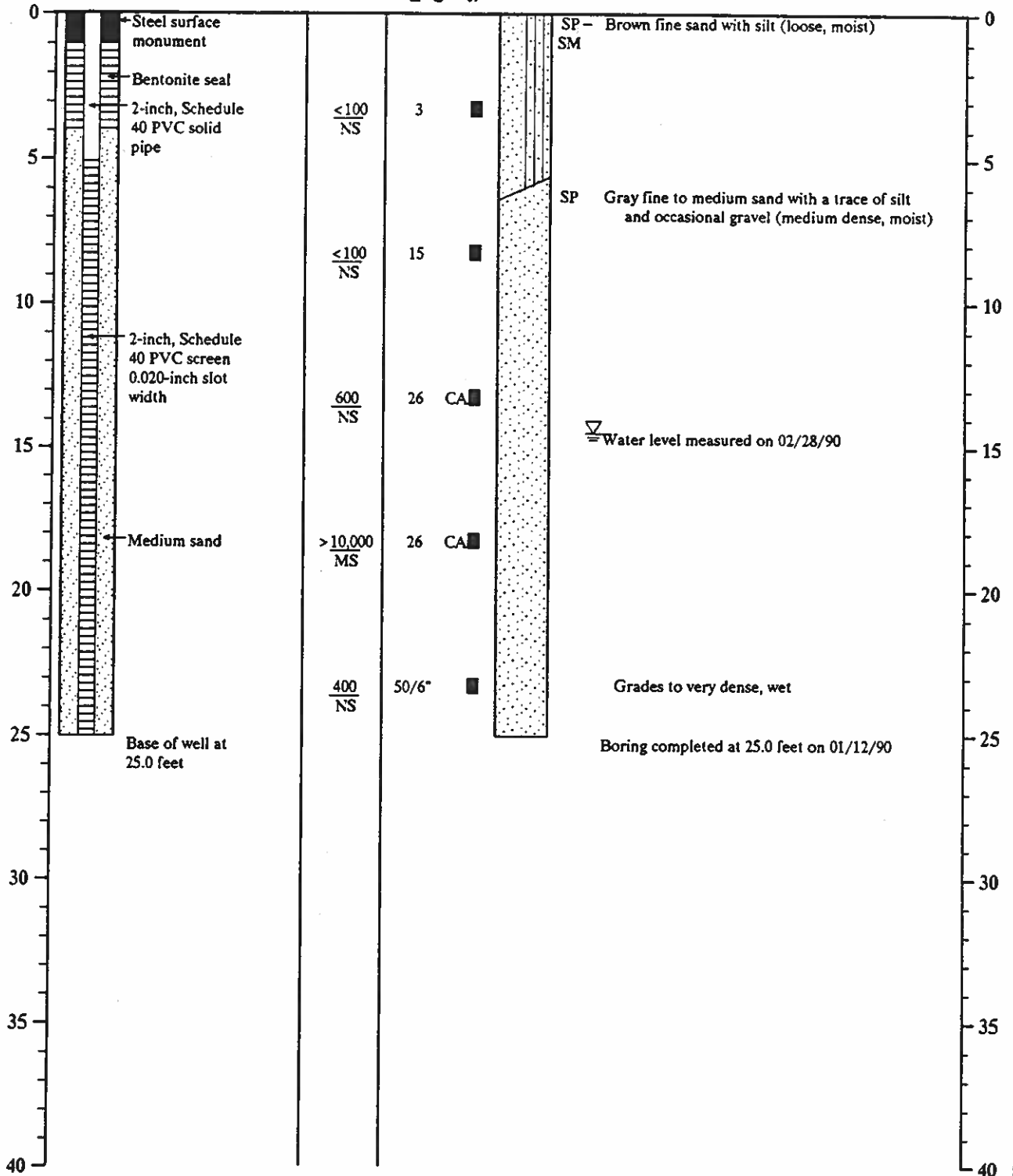
Vapor  
Conc. (ppm)  
Sheen

Blow-  
Count  
Samples

Group  
Symbol

DESCRIPTION

Surface Elevation: 101.44



Note: See Figure A-2 for explanation of symbols

:LRM:CLH:IRA 6/13/90

0372-066-B04



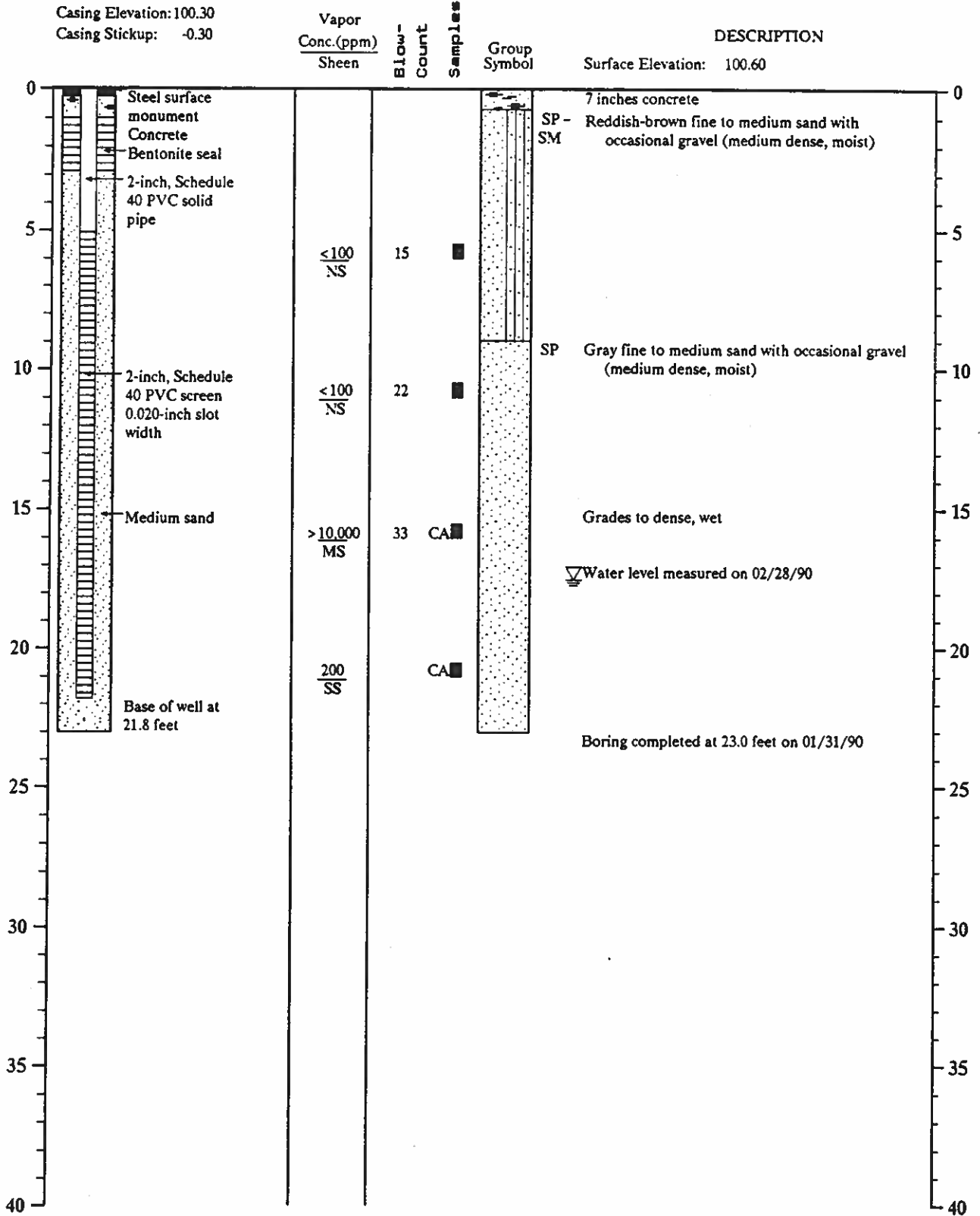
Log of Monitor Well

Figure A-5

# MONITOR WELL NO. MW-4

## WELL SCHEMATIC

Casing Elevation: 100.30  
Casing Stickup: -0.30



Note: See Figure A-2 for explanation of symbols

:LRM:CLH:IRA 6/13/90

0372-068-B04



Log of Monitor Well

Figure A-6

# MONITOR WELL NO. MW-5

**WELL SCHEMATIC**

Casing Elevation: 100.75  
 Casing Stickup: -0.25

Vapor  
 Conc.(ppm)  
 Sheen

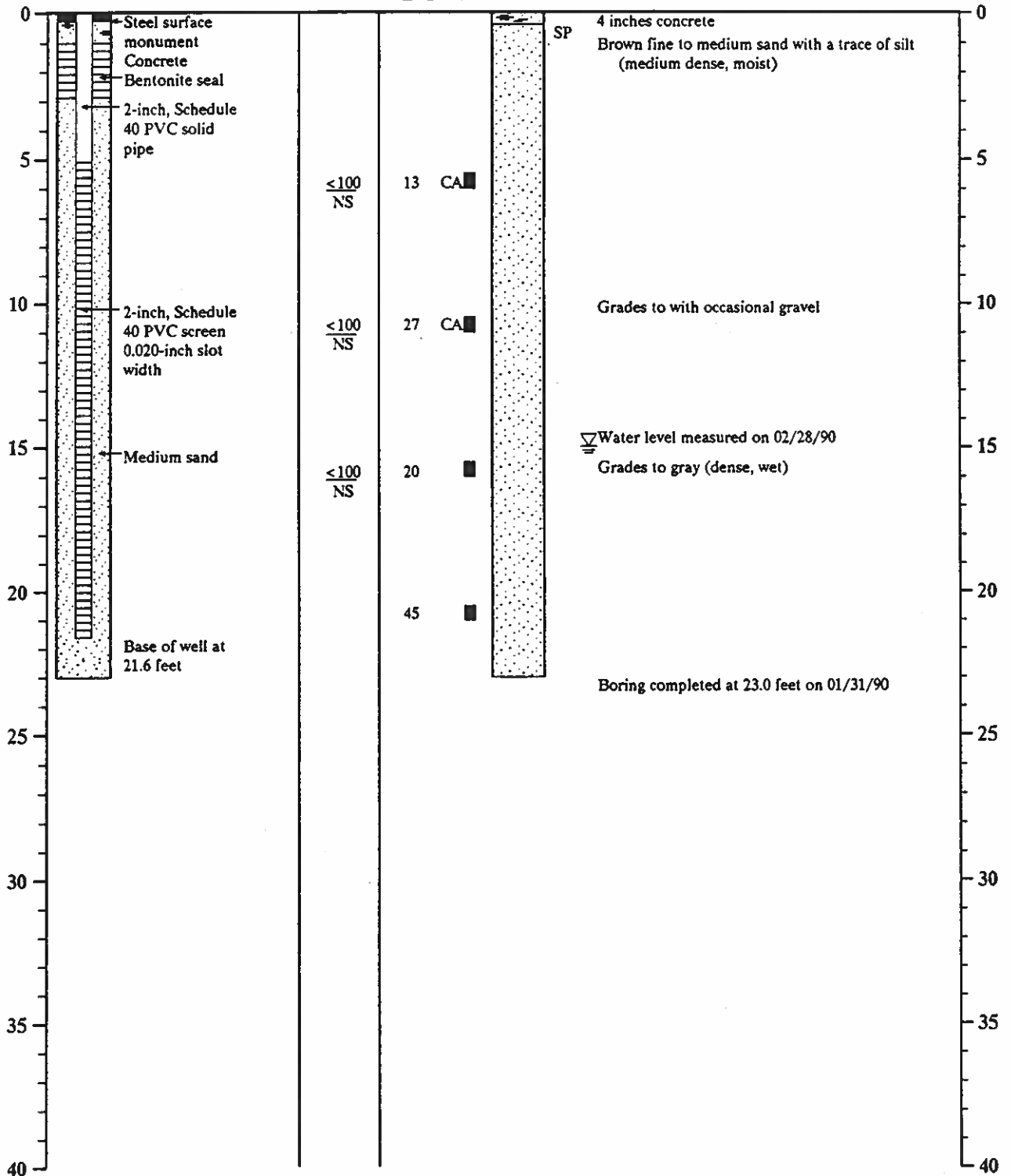
Blow-  
 Count

samples

Group  
 Symbol

**DESCRIPTION**

Surface Elevation: 101.00



Note: See Figure A-2 for explanation of symbols

: LRM: CLH: IRA 6/13/90

0372-068-804



**Log of Monitor Well**

**Figure A-7**



# MONITOR WELL NO. MW-6

## WELL SCHEMATIC

Casing Elevation: 100.83

Casing Stickup: -0.28

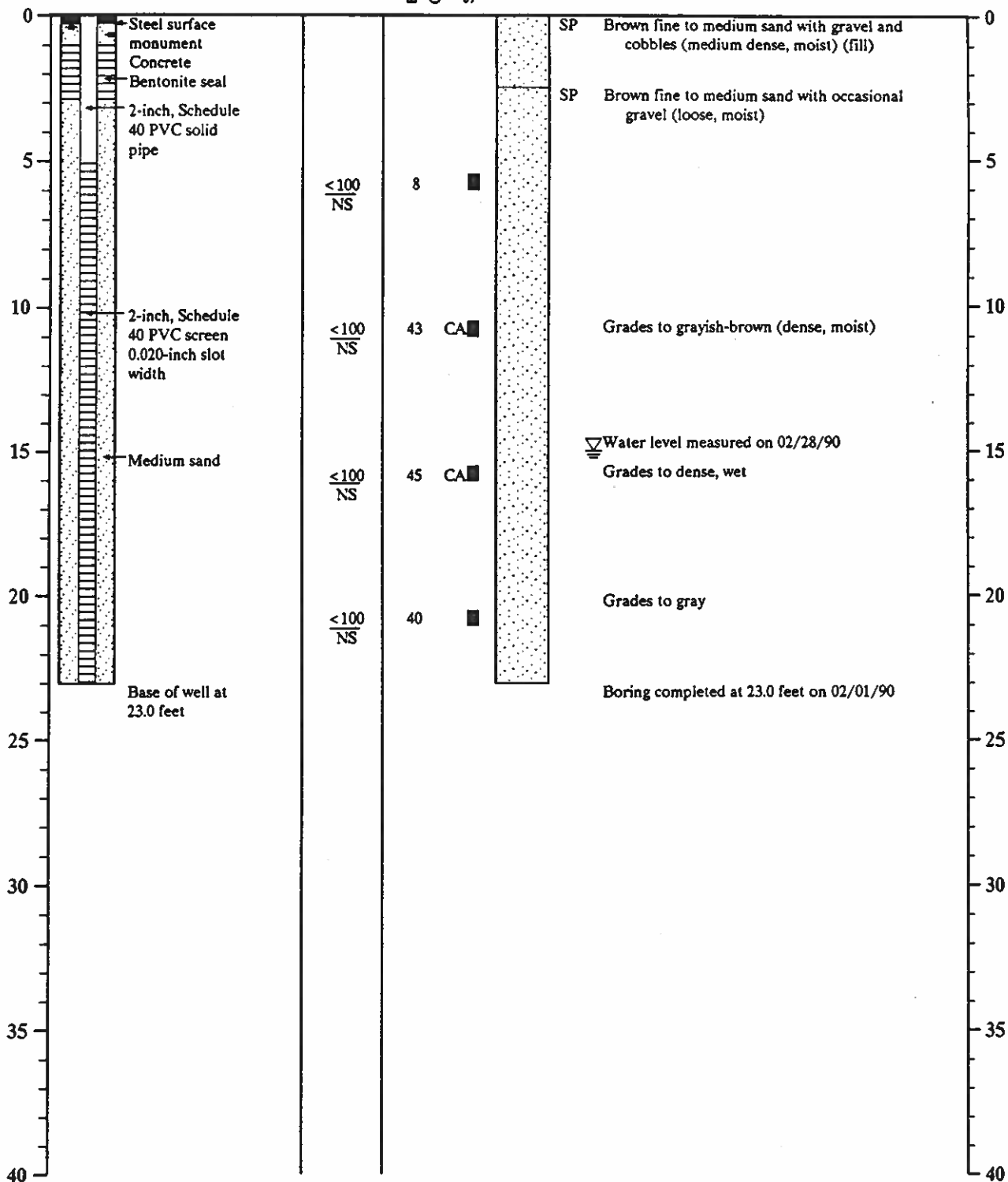
Vapor  
Conc.(ppm)  
Sheen

Blow-  
Count  
Samples

Group  
Symbol

## DESCRIPTION

Surface Elevation: 101.11



Note: See Figure A-2 for explanation of symbols

: LRM: CLH: IRA 6/16/90

0372-068-B04



Log of Monitor Well

Figure A-8

# MONITOR WELL NO. MW-7

## WELL SCHEMATIC

Casing Elevation: 99.07  
Casing Stickup: -0.83

Vapor  
Conc.(ppm)  
Sheen

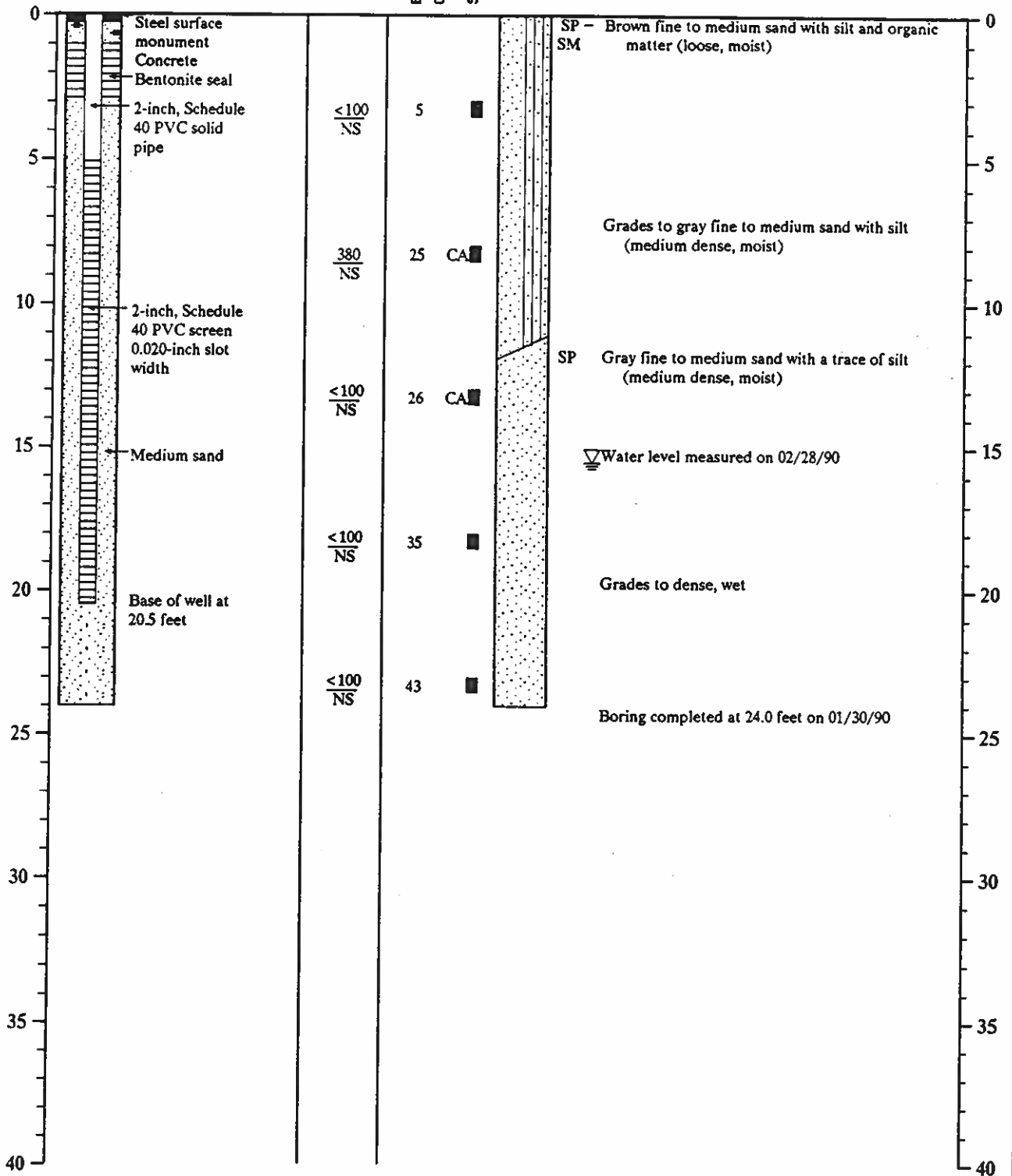
Blow-  
Count

Samples

Group  
Symbol

## DESCRIPTION

Surface Elevation: 99.90



Note: See Figure A-2 for explanation of symbols

:LRM:CLH:IRA 6/13/90

0372-066-B04



Log of Monitor Well

Figure A-9

# MONITOR WELL NO. MW-8

## WELL SCHEMATIC

Casing Elevation: 98.97  
 Casing Stickup: -0.53

Vapor  
 Conc.(ppm)  
 Sheen

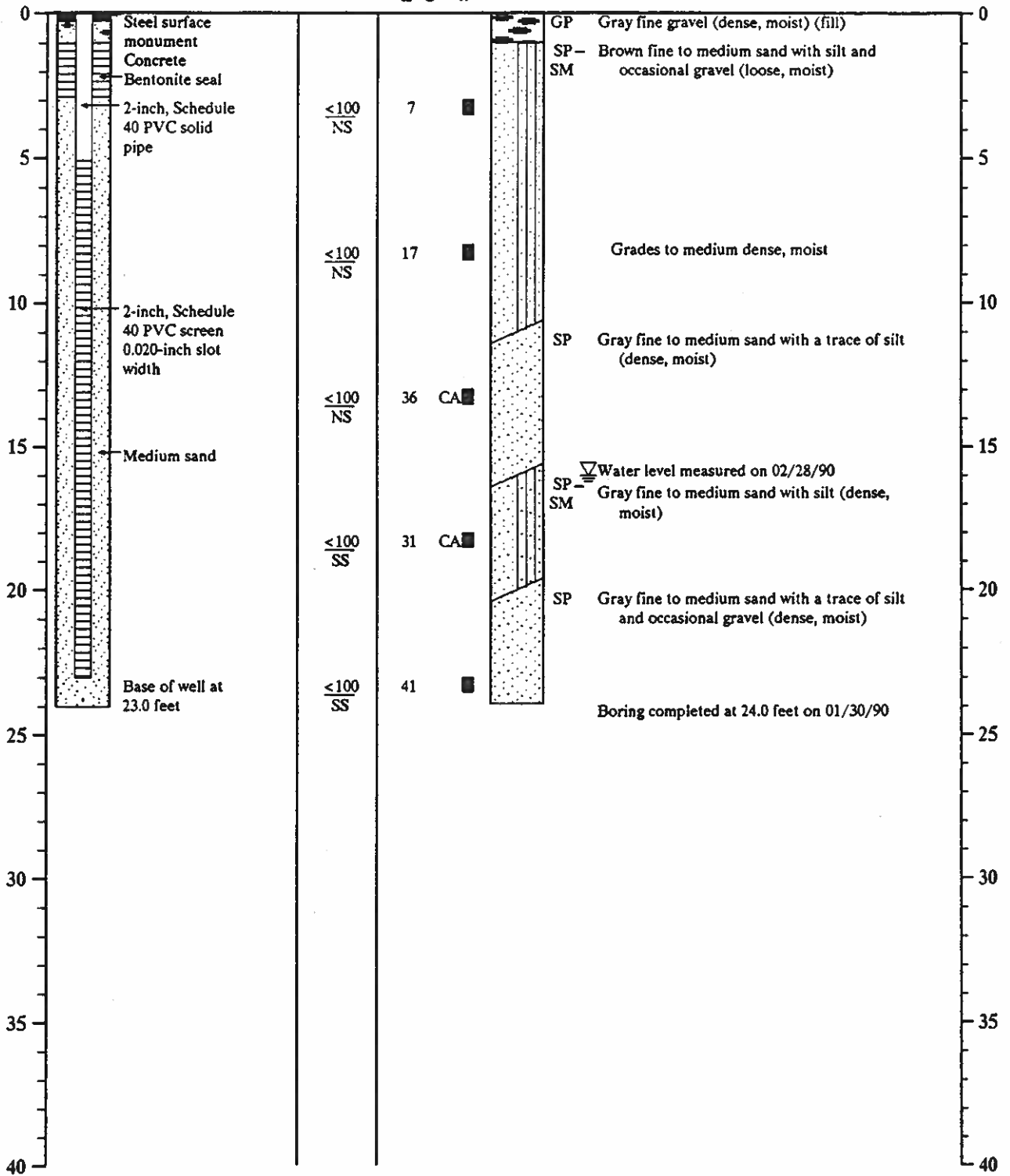
Blow-  
 Count

Samples

Group  
 Symbol

DESCRIPTION

Surface Elevation: 99.50



Note: See Figure A-2 for explanation of symbols

0372-068-804 : LRM: CLH: IRA 6/13/90



Log of Monitor Well

Figure A-10

# MONITOR WELL NO. MW-9

## WELL SCHEMATIC

Casing Elevation: 100.02  
Casing Stickup: -0.41

Vapor  
Conc.(ppm)  
Sheen

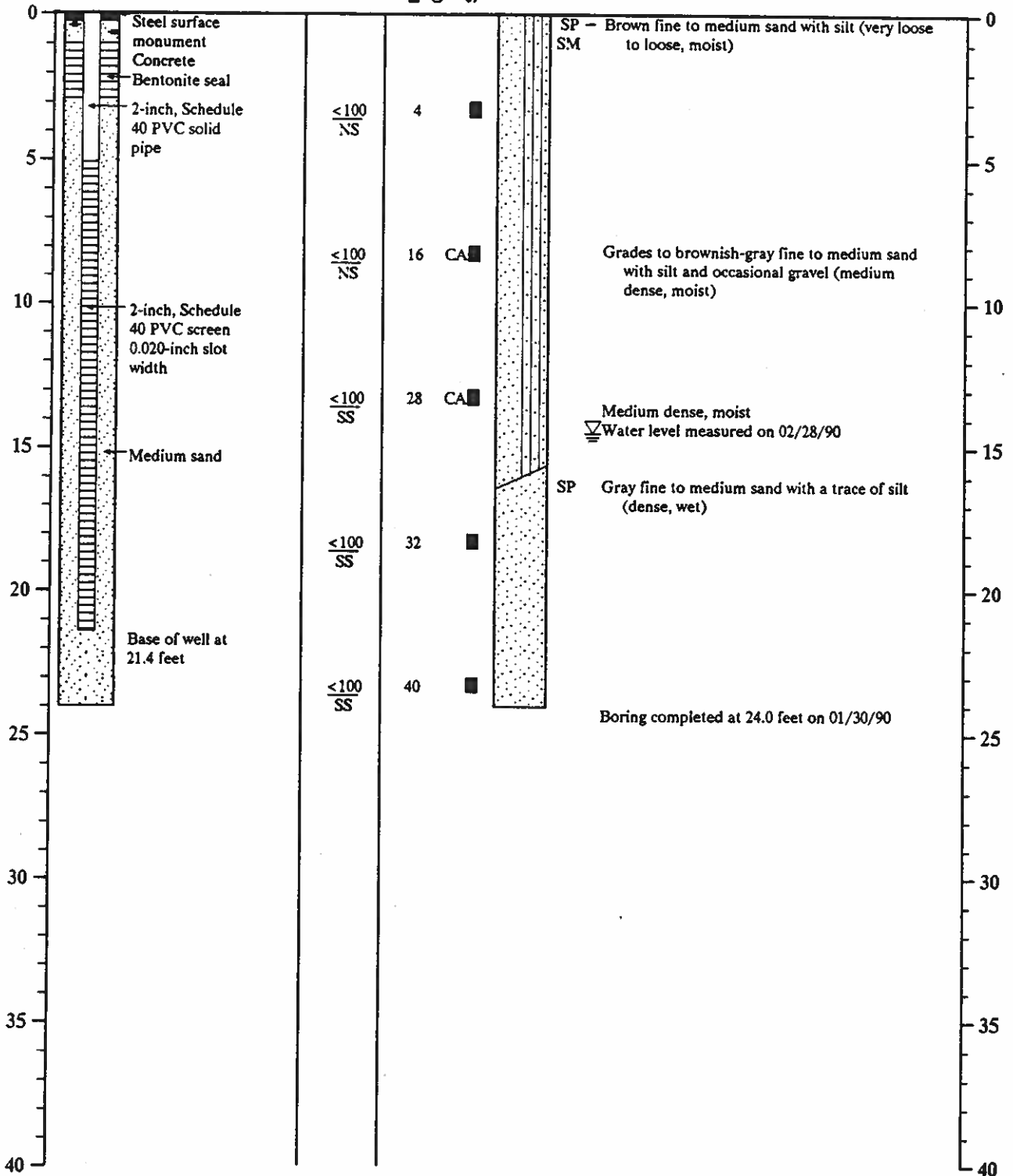
Blow-  
Count

Samples

Group  
Symbol

## DESCRIPTION

Surface Elevation: 100.41



Note: See Figure A-2 for explanation of symbols

:LRM:CLH:IRA 6/13/90

0372-868-804

# MONITOR WELL NO. MW-10

## WELL SCHEMATIC

Casing Elevation: 99.18

Casing Stickup: -0.19

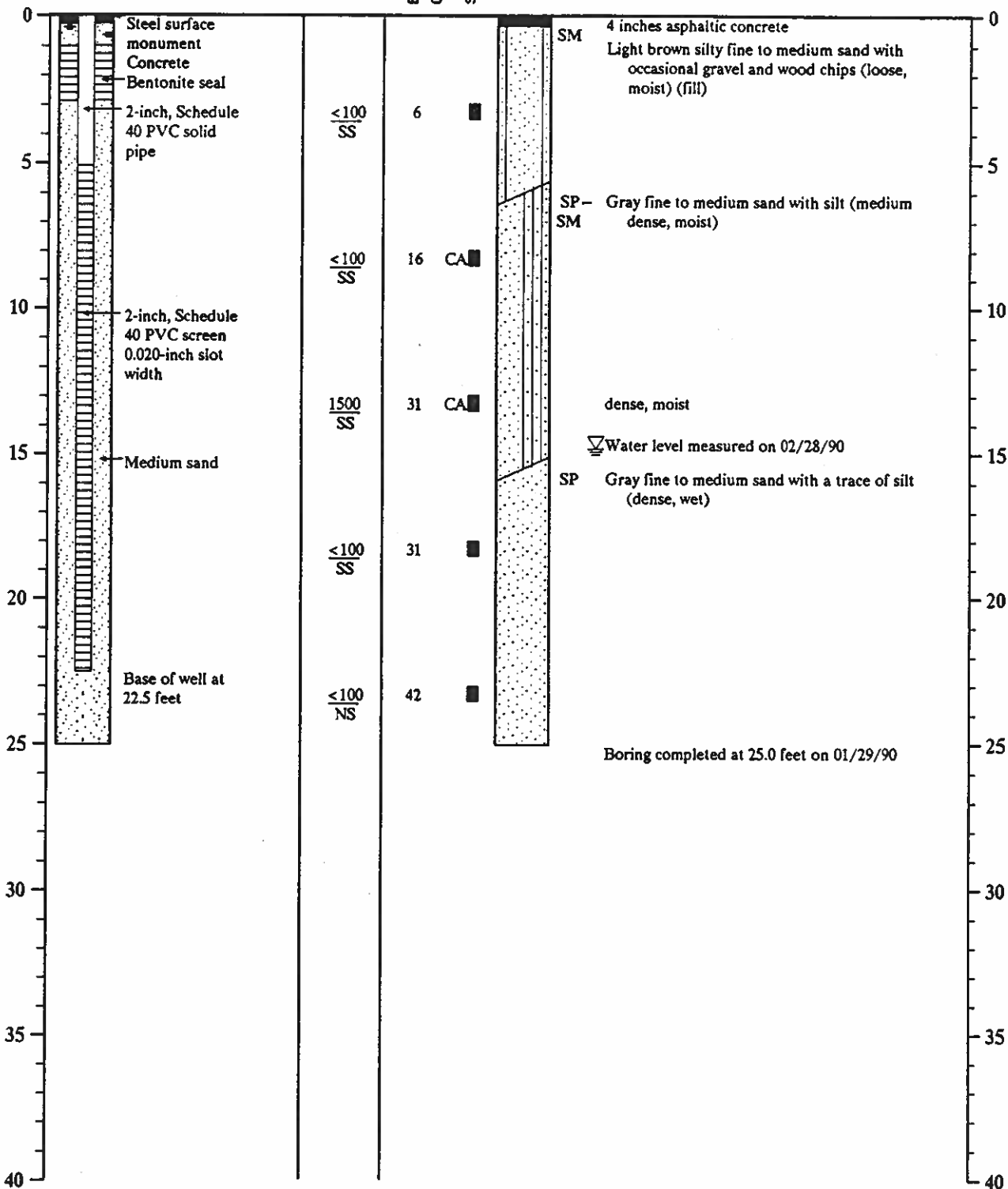
Vapor  
Conc.(ppm)  
Sheen

Blow-  
Count  
Samples

Group  
Symbol

DESCRIPTION

Surface Elevation: 99.37



Note: See Figure A-2 for explanation of symbols

:LRM:CLH:IRA 6/15/90

0372-068-B04



Log of Monitor Well

Figure A-12

# MONITOR WELL NO. MW-11

## WELL SCHEMATIC

Casing Elevation: 98.43  
Casing Stickup: -0.57

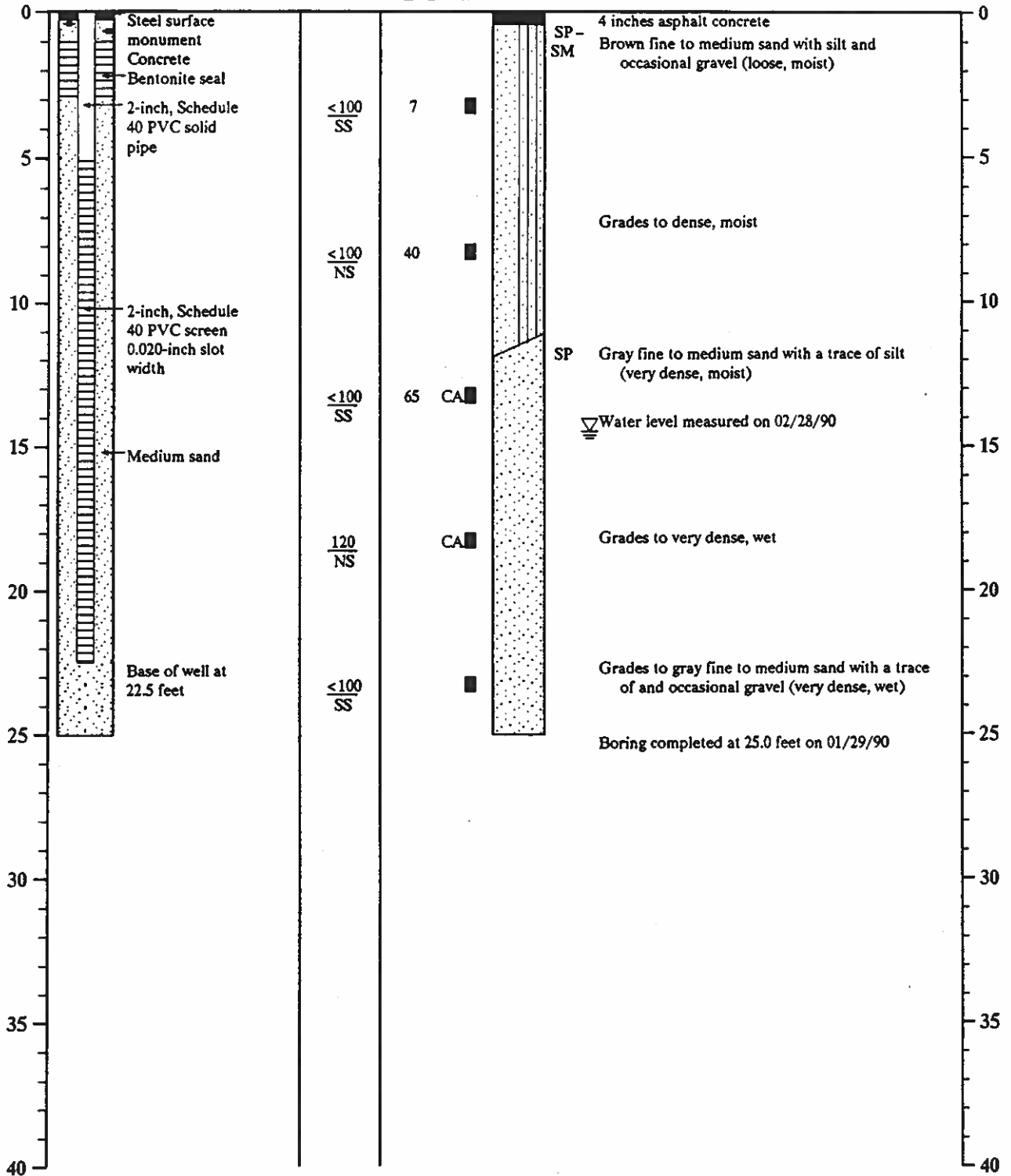
Vapor  
Conc.(ppm)  
Sheen

Blow-  
Count  
Samples

Group  
Symbol

DESCRIPTION

Surface Elevation: 99.00



Note: See Figure A-2 for explanation of symbols

: LRM: CLH: IRA 6/15/90

0372-068-B04



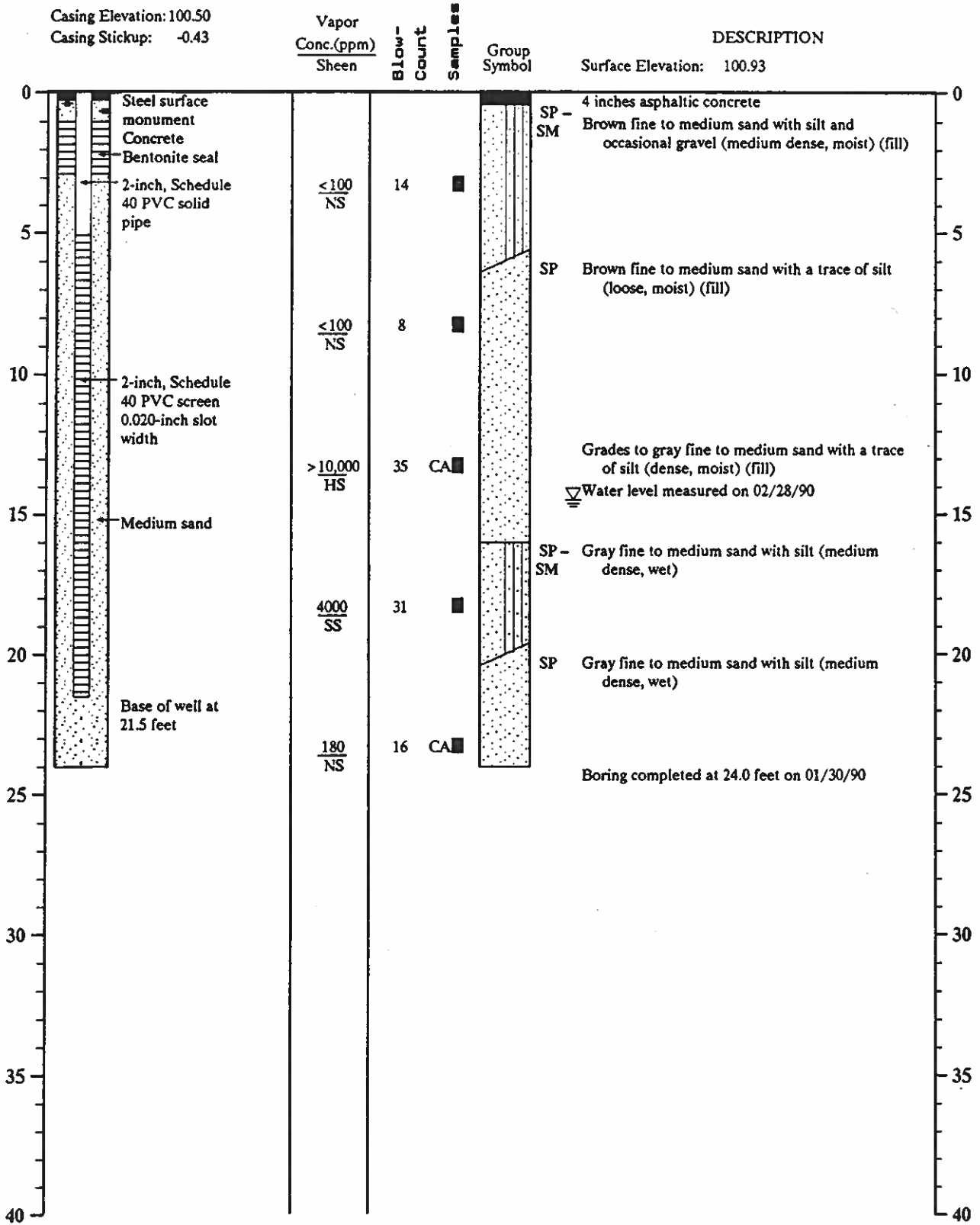
**Log of Monitor Well**

**Figure A-13**

# MONITOR WELL NO. MW-12

## WELL SCHEMATIC

Casing Elevation: 100.50  
Casing Stickup: -0.43



Note: See Figure A-2 for explanation of symbols

: LRM:CLH:IRA 6/13/90

0372-068-B04



Log of Monitor Well

Figure A-14

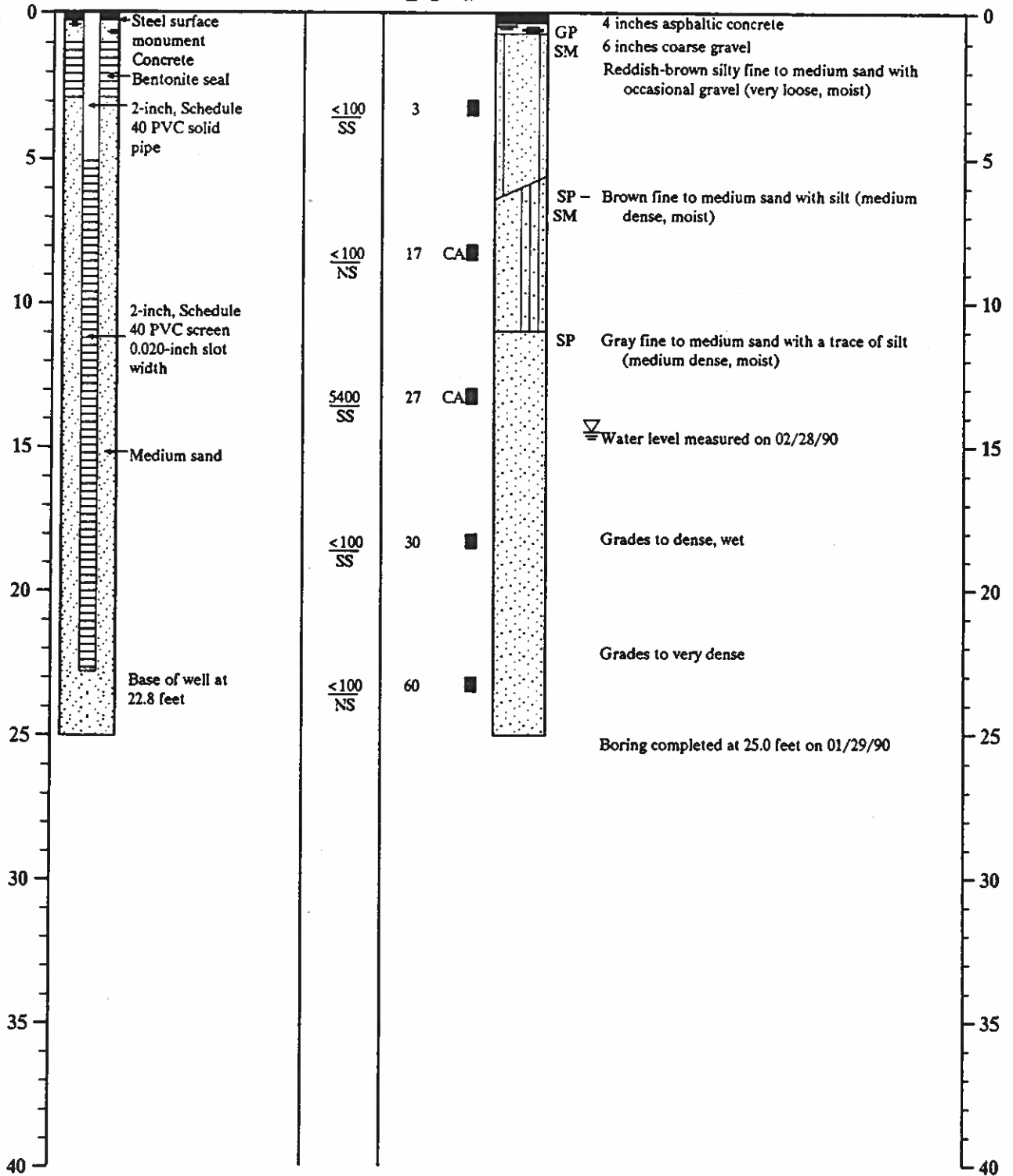
# MONITOR WELL NO. MW-13

## WELL SCHEMATIC

Casing Elevation: 99.01  
Casing Stickup: -0.30

Surface Elevation: 99.31

Vapor Conc.(ppm) Sheen	Blow- Count	Samples	Group Symbol	DESCRIPTION
------------------------------	----------------	---------	-----------------	-------------



Note: See Figure A-2 for explanation of symbols

: LRM: CLH: IRA 6/13/90

0372-068-B04



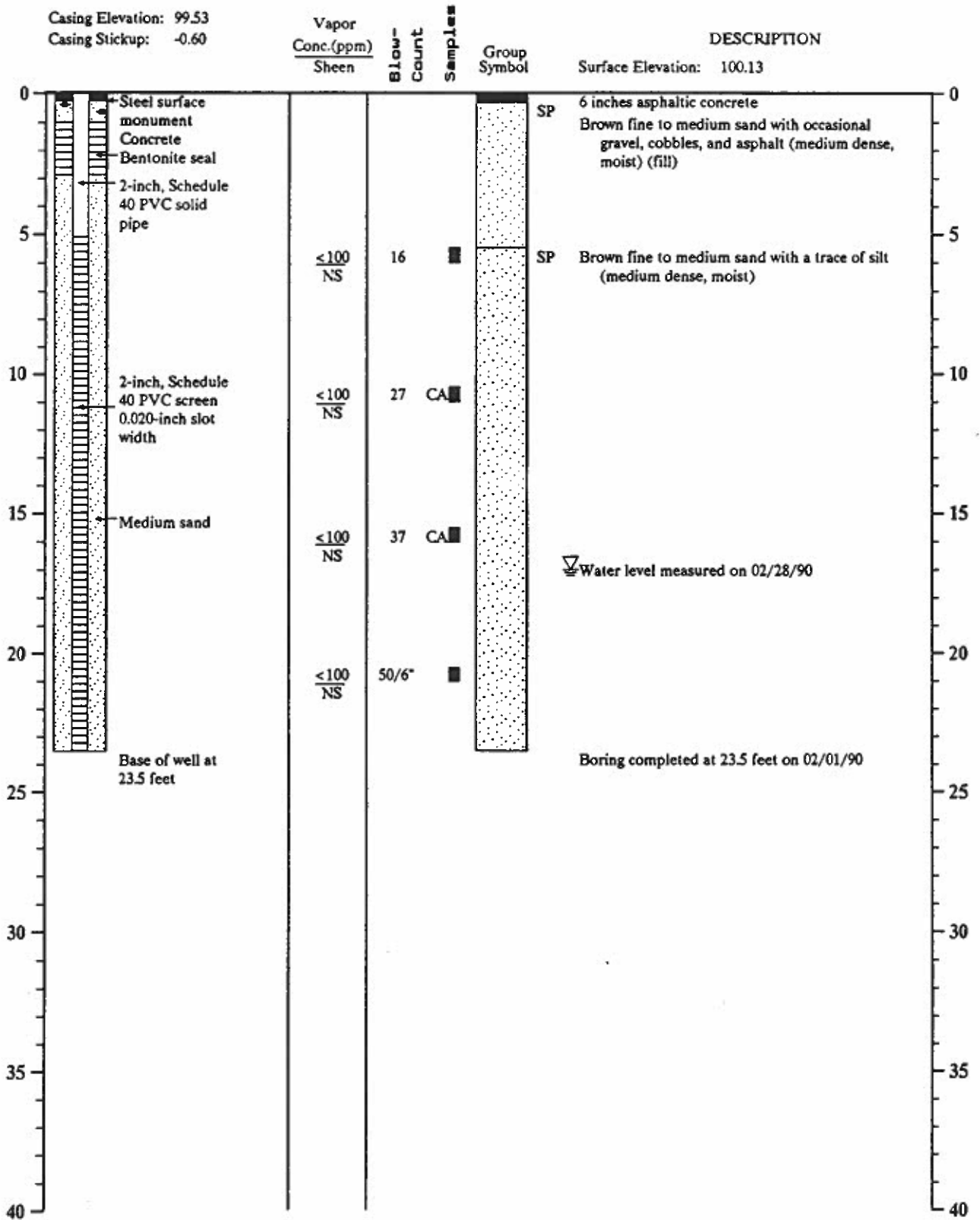
# MONITOR WELL NO. MW-14

**WELL SCHEMATIC**

Casing Elevation: 99.53  
 Casing Stickup: -0.60

**DESCRIPTION**

Surface Elevation: 100.13



Note: See Figure A-2 for explanation of symbols

:LRM:CLH:IRA 6/13/90

0372-068-B04



**Log of Monitor Well**

**Figure A-16**

# RECOVERY WELL NO. RW-1

## WELL SCHEMATIC

Casing Elevation: 98.36  
 Casing Stickup: 1.97

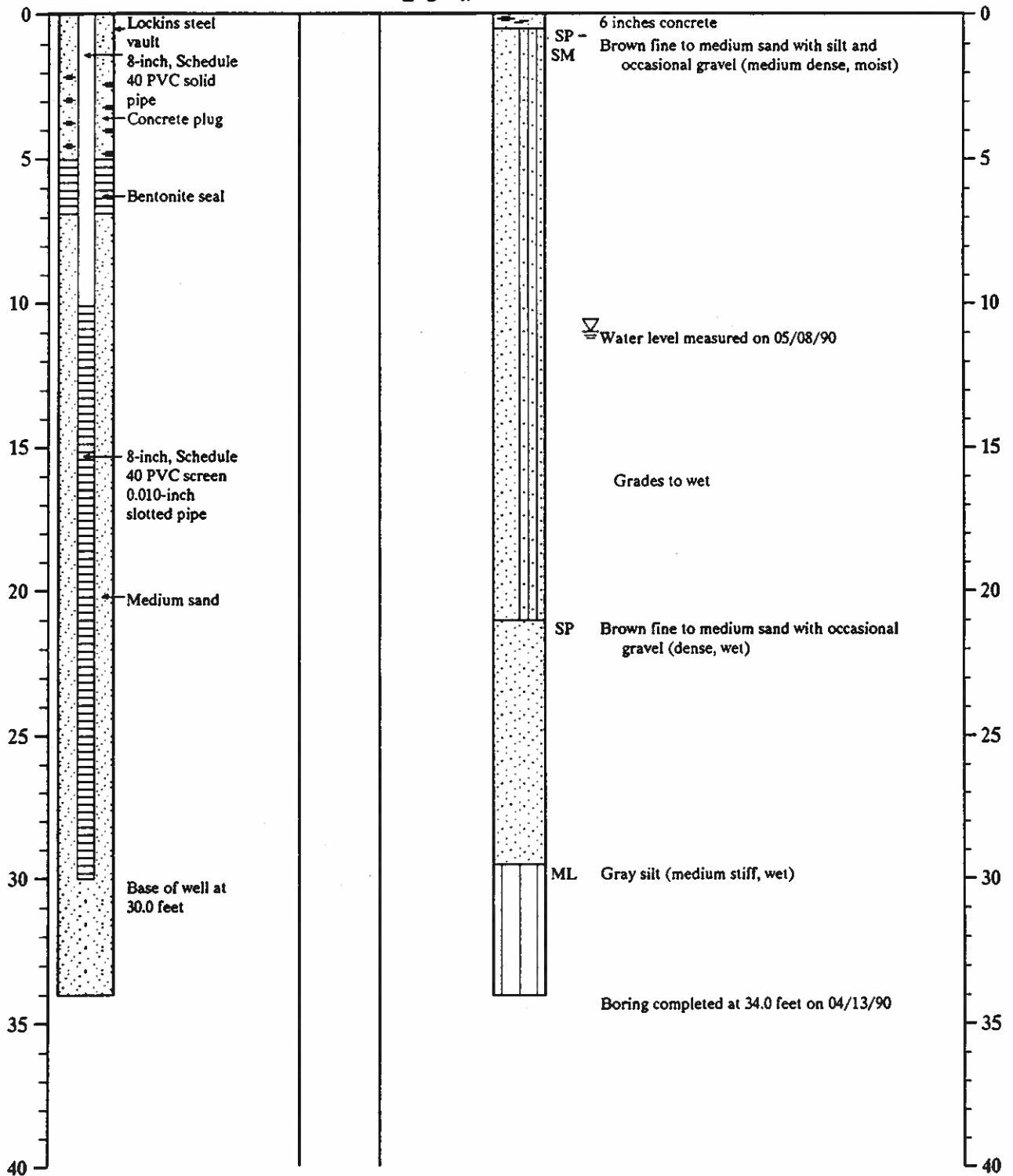
Vapor  
 Conc.(ppm)  
 Sheen

Blow-  
 Count  
 Samples

Group  
 Symbol

## DESCRIPTION

Surface Elevation: 100.33



Note: See Figure A-2 for explanation of symbols

: LRM:CLH: IRA 6/15/90

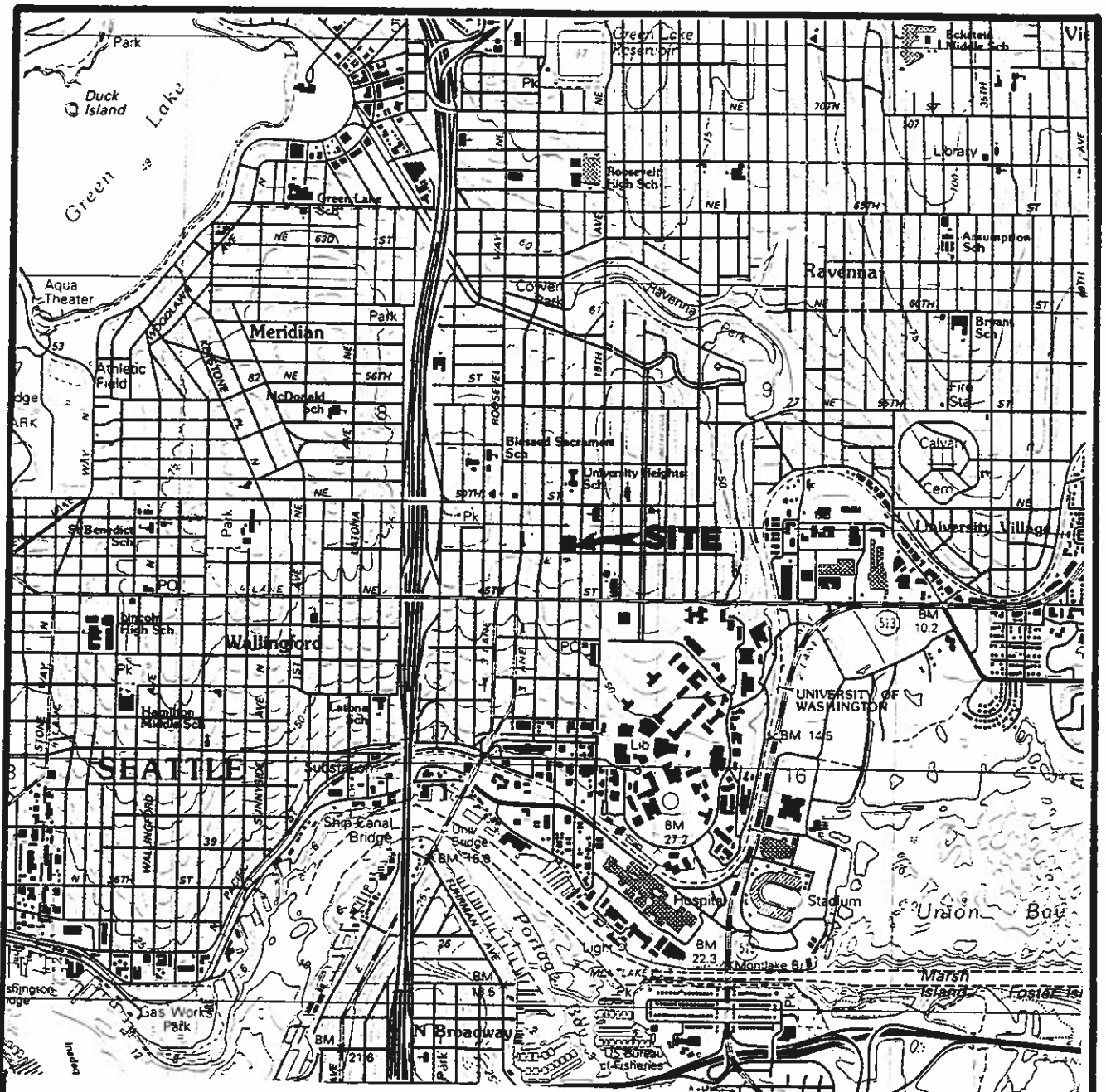
0372-069-B04



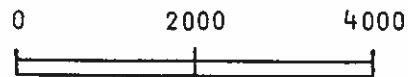
Log of Recovery Well

Figure A-17

0372.068.B04 CLH:KKT 5-15-90



REFERENCE: USGS 7.5'X15' TOPOGRAPHIC-BATHYMETRIC QUADRANGLE MAP "SEATTLE NORTH, WASHINGTON".



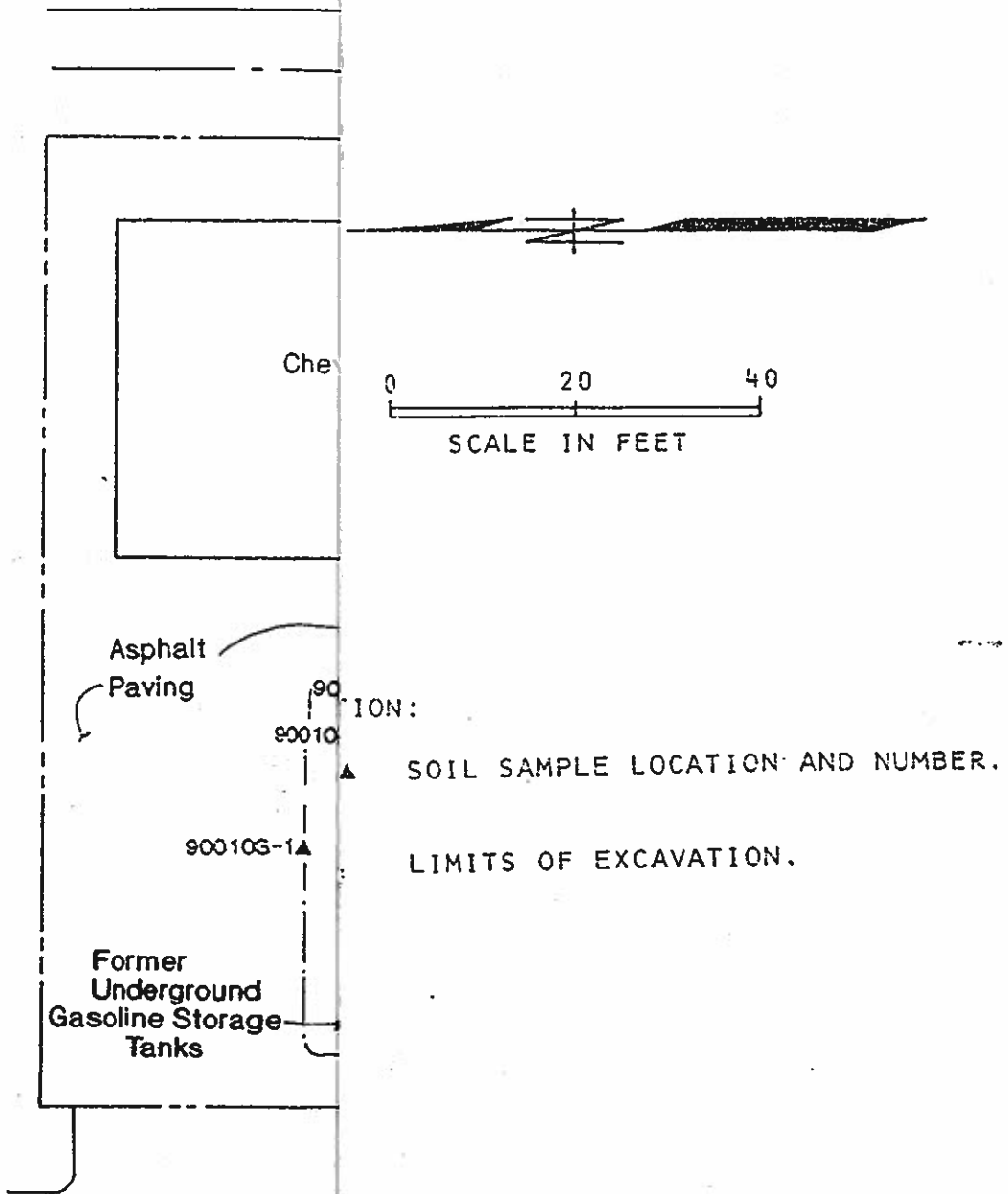
SCALE IN FEET

Geo  Engineers

VICINITY MAP

FIGURE 1

2002-000-804 C-10-10N 2-10-93

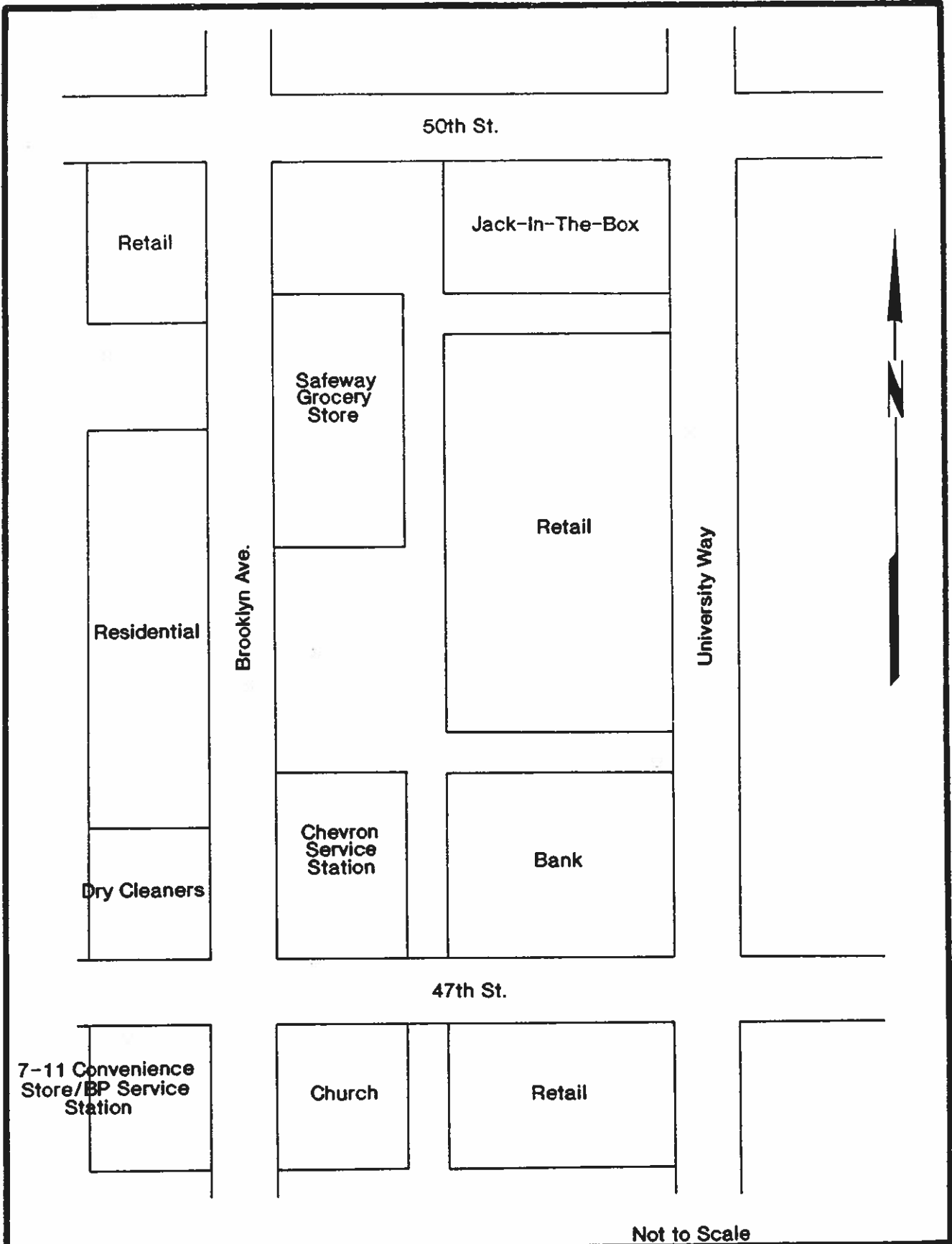


REFERENCE: DRAWING ENTITLED "SITE PLAN"  
BY ROBERT H. LEE & ASSOCIATES  
5/25.89.

**SITE PLAN**

**FIGURE 2**

0372-068-BO4 REJ:BDH 11.6.90



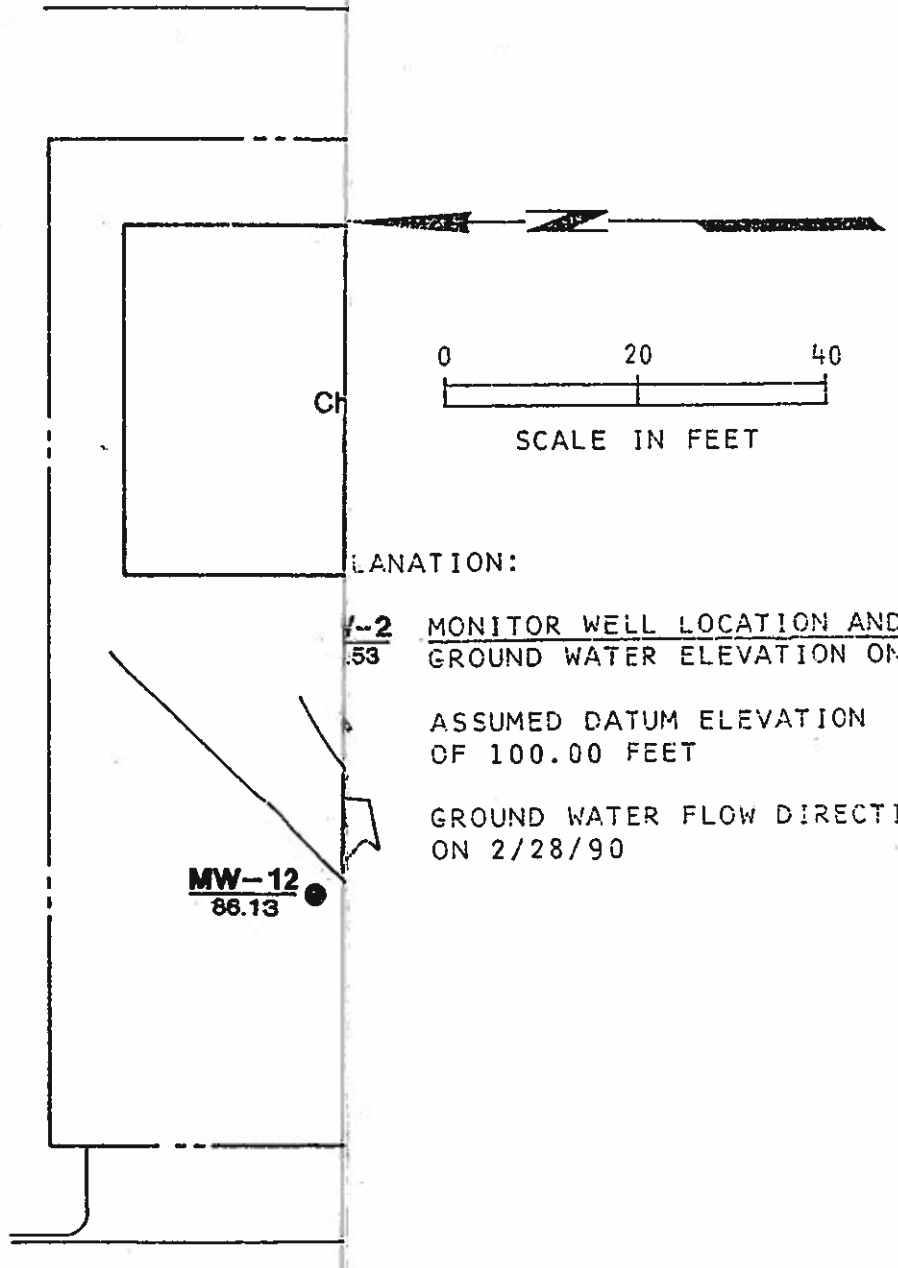
Not to Scale

Geo  Engineers

**SURROUNDING PROPERTY**

**FIGURE 3**

0372-068-B04 CLH:KKT 3-9-90



CH

0                      20                      40  
 ───────────────────┬──────────────────┬──────────────────  
 SCALE IN FEET

EXPLANATION:

MW-12    MONITOR WELL LOCATION AND NUMBER  
86.13      GROUND WATER ELEVATION ON 2/28/90

ASSUMED DATUM ELEVATION  
 OF 100.00 FEET

GROUND WATER FLOW DIRECTION  
 ON 2/28/90

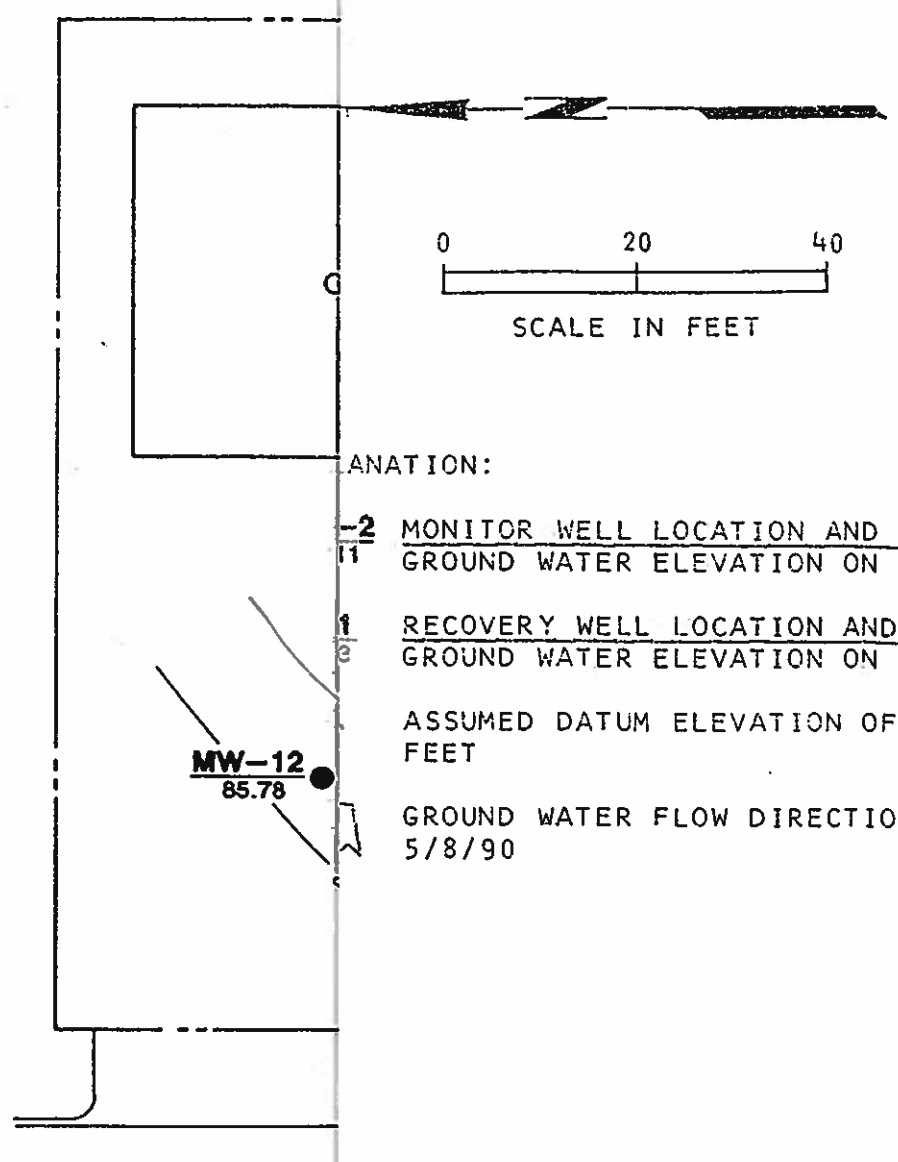
**MW-12**  
 86.13 ●

REFERENCE: DRAWING ENTITLED  
 BY ROBERT H.  
 5/25/89.

**GROUND WATER CONTOUR MAP ON 2/28/90**

**FIGURE 4**

0372-068-B04 CLH:KLT 3.9.90



**MW-12**  
85.78

EXPLANATION:

-2 MONITOR WELL LOCATION AND NUMBER  
GROUND WATER ELEVATION ON 5/8/90

1 RECOVERY WELL LOCATION AND NUMBER  
GROUND WATER ELEVATION ON 5/8/90

ASSUMED DATUM ELEVATION OF 100.00  
FEET

GROUND WATER FLOW DIRECTION ON  
5/8/90

REFERENCE: DRAWING ENTIRELY  
BY ROBERT H.  
5/25/89.

**GROUND WATER CONTOUR MAP ON 5/8/90**

**FIGURE 5**